FLIGHT
and
The AIRCRAFT ENGINEER

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The Outlook

"Mischief-makers"

A STRONG Government usually welcomes criticism, provided that it is not merely malicious or used for purely party purposes. Criticism cannot always be constructive; those who see what is wrong may not always be in a position to suggest means for putting things right. If there were nothing which ought to be destroyed, there would be nothing to criticise.

Sir Archibald Sinclair, Secretary of State for Air, speaking on September 3rd at a luncheon of the National Defence Public Interest Committee, is reported to have said: "The R.A.F. had been proud to play its part in contributing to the achievements of the Army. The mischief-makers who would try to persuade us that the R.A.F. was too busy with its own affairs to concern itself about the Army were wrong-headed. It was true that in the past shortages of aircraft and equipment made it necessary to concentrate all available resources on providing the essential means of victory in air war, but they liked to co-operate with the Army. They were determined to work and train with the Army so as to improve that co-operation, and now with the additional resources available that co-operation would become ever closer and more fruitful."

"Mischief-makers" and "wrong-headed" are terms which would indicate objection to criticism. There is an old sarcastic maxim in the legal profession that when you have a bad case you should abuse the other side's advocate. Is Sir Archibald inwardly conscious that he has a bad case? Books published about the R.A.F. in France make it clear that the B.E.F. was let down by the R.A.F. Shortage of aircraft was, no doubt, the reason, but was it a sufficient excuse? Wiser planning beforehand ought to have avoided that result; and it would be interesting to know how much say the Army had in the planning beforehand. But then the Army, having no air arm of its own, is not in a good position to say what it really ought to have, and may be inclined to trust the assurances of the Air Ministry that it will be all right on "the day."

A Lesson from Australia

IN the African campaigns there was, to all appearance, grand co-operative work between the two Services, but it is disturbing to find the Australian Commander-in-Chief, Lieut. Gen. Sir Iven Mackay, asserting, if he has been correctly reported, that in the Libyan campaign the co-operation was not good enough. As a result, it has been announced in Canberra that a large number of aircraft are to be attached to the Australian forces in the Middle East, and placed under the control of the Army. This must apply to squadrons other than the tactical reconnaissance units which are called Army Co-operation Squadrons, as these have always been under the operational control of the Army. Something much more far-reaching is indicated. We cannot help wondering whether Sir Archibald Sinclair would include Sir Iven Mackay among the "wrong-headed mischief-makers."

The Air Ministry is able to boast that it has established the Army Co-operation Command to deal with all questions between the two Services. Recently the Air Ministry News Service issued a bulletin headed "Secrets of the Army Co-operation Command." Naturally, it did not reveal any secrets, but the subjects which it did mention gave small comfort to the "wrong-headed

mischief-makers" who doubt if all is well. It mentioned parachute troops (very useful on occasions, but not every day), artillery observation (already thoroughly studied by the tactical reconnaissance squadrons in their time-honoured Lysanders), anti-aircraft defence, and photographic reconnaissance (also a stock function of the tactical reconnaissance squadrons), and some minor matters. Nothing in the document suggests that anything beyond tactical reconnaissance is considered; there is nothing that points to achieving, or even aiming at, Gen. Mackay's ideal of an air arm trained to work with the Army up to the German standard. Perhaps all the rest is being done, but is covered by the word "secret." We must hope that it is so, but until it is possible to give the public some assurance on these points, we think that Sir Archibald is rather ungenerous to dub those who feel honest misgivings, based on past unpleasant experiences, as "mischief-makers and wrong-headed."

General Wavell Speaks

WHEN General Wavell fights, his enemies are sure to meet with a surprise. When he talks or writes, his opinions command respect and set his hearers or readers thinking. On the anniversary of the outbreak of war he gave a broadcast from Simla which deserves and will receive study. While mentioning that the fighting forces of India were approaching the million mark, he regretted that the Indian Air Force had not expanded so rapidly as might be wished. One wonders why that is so, but probably shortage of training facilities and equipment may have something to do with it. However, on the manufacturing side, he told us all that the first aircraft to be produced in India had already been flown. That is welcome news, and we hope for an ever-increasing supply from that source; though there must be difficulties in getting large-scale factory results from a population which is overwhelmingly agricultural.

Another passage in General Wavell's speech which has a bearing on the subject of air power was his assertion that the enemy losses in Crete had certainly cost the Germans Iraq and Syria. The men who fought in Crete are sore that they did not receive due support from the air, but now they have been told by an authority whom few will doubt that their sacrifice had a most advantageous effect on the war in the Middle East. That will be to them a great consolation.

Oil for Russia

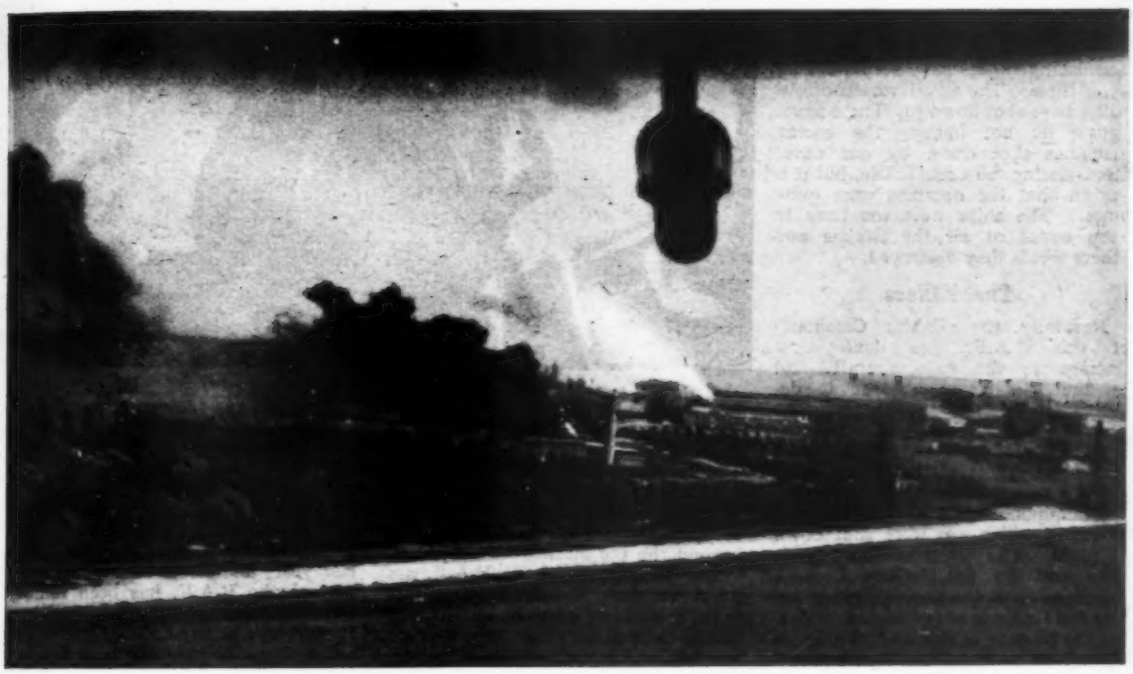
IN the first months of the war, when Germany and Russia were to all appearances on good terms with each other, economists spent much time, ink and paper in calculating how much oil Russia could spare from her own needs and make over to Germany. If the final figure arrived at was on the low side, sceptical readers were apt to exclaim, "Wishful thinking." Now the oil tankers from the U.S.A. are arriving at Vladivostock, to the great annoyance of Japan.

We may feel confident that the United States is not anxious to do anything in the nature of sending coals to Newcastle, and so we must conclude that the aforesaid estimates of Russian oil exports to Germany were not calculated at too low a rate, but must have been actually exaggerated.

FOR ATTENTION AND NECESSARY ACTION: A damaged Wellington fuselage in the first stages of treatment at a Repair Depot. If the damage is too severe the usable parts are removed and the remainder "reduced to produce."

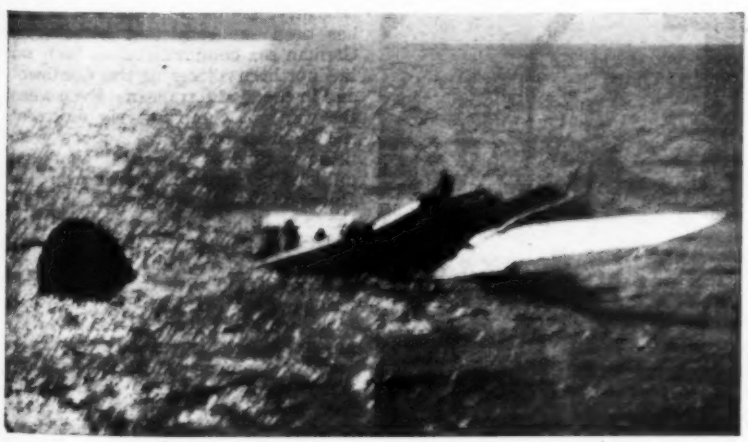
War in the Air

Profit and Loss Account : Attacks on Axis Sea Communications



ROTTERDAM DOCK RAID : These low-flying daylight attacks by Blenheims of Bomber Command are made roughly in line abreast to prevent following machines being blown up by the bombs of the aircraft in front.

THE Prime Minister not long ago warned us to be ready for September 1st. Well, the Ides of March have come and have passed, but nevertheless we should none of us be surprised if any night now the German bombers resumed their visitations. There has recently been a nasty raid on Hull, which did some damage and caused some casualties. But the Germans are still busy in Russia, and it has been estimated (though there are natural difficulties about estimation) that the *Luftwaffe* has lost 4,000 machines to the Russians. Such a loss would not prevent the enemy from staging some heavy attacks on Great Britain, but, even if the estimate is not correct, the *Luftwaffe* has certainly lost a great number of bombers, and will not be in such a strong position for attacking Great Britain as it was last winter.



WHERE IS THE ITALIAN NAVY? The crew of an Italian Savoia Marchetti 79 —shot down in the Mediterranean—wait to be picked up by a British destroyer. From the attitude of the machine in the water it is probable that automatically inflated flotation gear is carried in the bomb bay.

The end of the second year of war is an appropriate occasion for adding up losses on both sides. A general estimate of Axis losses since the beginning of the war, excluding the Russian campaign, is 8,000 machines, of which the largest item is 3,038 lost over Great Britain during 1940. The second largest item is 1,696 lost in the Middle East during 1941. Most of these belonged to the luckless *Regia Aeronautica*, and the profit and loss account there is particularly gratifying because the Italians (with German help of late) only succeeded in shooting down 312 British Empire machines as an offset.

The Royal Navy and the Merchant Navy, by gunfire and by Fleet Air Arm fighters, have destroyed or

WAR IN THE AIR

NOT SO EASY AS IT LOOKS. The bomb aimer of a Short Stirling gets ready for business.

damaged over 1,000 enemy aircraft since the beginning of the war, of which 543 have been certainly destroyed. The guns on merchant ships and fishing vessels have accounted for 55 of these. The naval vessels of our Allies have shot down 12. These naval figures do not include the enemy machines shot down by our naval forces during the Crete battle, but it is known that the numbers were quite large. The ships were too busy to keep count of all the Stukas and others which they destroyed.

The Killers

Naturally the Fighter Command of the R.A.F. has done most damage to the Axis aircraft, and in the two years of war it destroyed 4,500 enemy machines. The term Fighter Command includes the anti-aircraft guns which work under the orders of the A.O.C.-in-C. During 1941, so far as it has gone, the Command has accounted for over 1,000, of which 380 were shot down at night. The totals of the Fighter Command do not include German machines shot down over France before the Dunkerque evacuation or during the Norway campaign. If only we knew how many of the "probables" really failed to get home, our record would certainly be considerably more impressive. But the Germans know those figures, and that is what really matters.

It is interesting to note that there are now 15 fighter squadrons which have bagged over 100 enemy machines each, and three of them have gone beyond the 150 mark.

The total losses of the R.A.F. are 3,098 machines, and the heaviest item is the loss of 981 over enemy territory during the present year. Last year we lost 847 over and round Great Britain. It is worth putting a few of the figures in tabular form:—

	Axis	R.A.F.
Over and round G.B., 1940 ..	3,038	847
Over enemy territory in Europe, 1941	627	981

That comparison shows how terribly expensive was the German offensive last year, and how cheaply by comparison the R.A.F. has been raiding Germany and her occupied territory. It must also be remembered that when our raids on France bring back fighters from the eastern front, as they have been doing, our own sacrifices in the West may well mean the saving of more Russian machines and the destruction of more German machines (or tanks or soldiers) in the East, and so the Allied cause may be well up on the total deal. Incidentally, our raids also destroy some things on the ground which the Germans value.

While news from the Russian front is scanty, the chief air interest of late has been the consistent attacks on German sea communications both off the northern shores of the Continent and in the Mediterranean. Even when the war was comparatively quiescent the German transport systems were being worked to capacity. Now that millions of men are fighting on the Russian front the strain must be many times multiplied, and so sea transport became more important than ever before. The Coastal Command is chiefly charged with the task of interfering with it, and its Beauforts and other bombers have been doing so with gusto. *Flak* ships usually escort the tramp steamers, and E-boats are often seen. But our men go in through the hail of missiles and plant their bombs or launch their torpedoes. It is gallant work, and must be doing the enemy a lot of harm.

In the Mediterranean the enemy is now sending very strong naval escorts with his convoys to Tripoli, Bardia,

THAT'S BERLIN THAT WAS. First and second pilots of one of the Short Stirling bombers which have attacked Berlin.

FUEL FOR THE SPITFIRE : An R.A.F. armourer fitting a fresh magazine of ammunition to a shell-gun in the wing of a Spitfire V.

WAR IN THE AIR

and the other ports. One day last week a convoy of five merchant vessels with an escort of no less than seven destroyers was discovered off the south coast of Sardinia. The Fleet Air Arm attacked them at night with torpedoes, blew up one large merchant vessel, hit another amidships with a torpedo, and damaged two other smaller vessels. The attack took the escort by surprise, and the destroyers started firing wildly. Our naval airmen thought that the destroyers were firing on their own ships, and several of them narrowly missed collisions. An attack by torpedo-carrying aircraft at night must be very perplexing to naval gunners; they would probably be in doubt as to whether their attackers were submarines, surface warships, or air bombers. On the whole, one would not choose to be escorted by Italian warships.

The Fleet Air Arm had a night out on that particular night. While one squadron used torpedoes against the convoy, others bombed aerodromes in Sicily, shooting down one three-engined Italian bomber in flames over Gerbini and hitting another as it was coming in to land. Yet another contingent of naval aircraft attacked dumps at Gambut in Cyrenaica and started many fires. Heavy bombers of the R.A.F. were also busy that night, while next day S.A.A.F. fighters dealt faithfully with some enemy fighters which attempted to attack our forward landing grounds. Five of the enemy paid the penalty, and not one of our machines was lost throughout that rather hectic twenty-four hours.

BRITISH AIR LOSSES TO SEPT. 6th.

	Over G.B. Fighters	Over G.B. Pilots	Over Continent Aircraft	Middle East Aircraft
Aug. 31	0	0	10	0
Sept. 1	0	0	2	1
" 2	0	0	11	2
" 3	0	0	0	1
" 4	0	0	8	0
" 5	0	0	0	2
" 6	0	0	8	1
	0	0	39	7

Totals: Northern Area, 2,655; Middle East, about 377.

The Defence of Malta

THE enemy attacks on Malta continue at irregular intervals. On September 4th a large enemy formation attacked the island, but our fighters sent six down into the sea and knocked three others about so badly that it is not likely that they got home. Next day the Italians tried again, and in the morning a strong force of fighters was sighted. Our fighters intercepted them and shot down six Macchi 200s, and damaged others. Then our fighters went out to look for trouble, and in the afternoon found more Macchis off Sicily. Three of them were destroyed and others damaged, for the loss of two British machines. Fifteen certainties and at least three probables in two days is not bad going. But the Italians have resumed night bombing of the island, and in the darkness they manage to do a certain amount of damage.

Admiral Cunningham has sent a message to the Governor of Malta, in which he said: "Malta, in very truth, has proved a rock of strength to her friends and a thorn in the enemy's side." Sir William Dobbie replied, saying: "There is no one from whom we should rather have received a generous tribute. . . . We are conscious of the inestimable debt we owe to you for keeping our supply lines open these many months."

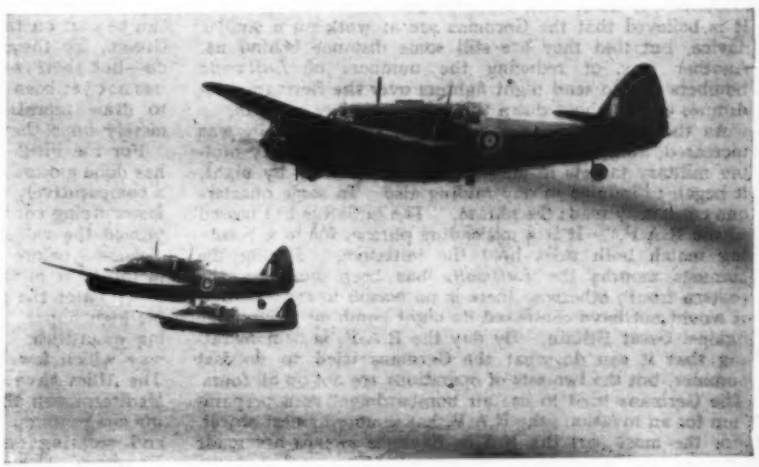
The Fleet Air Arm have added another enemy destroyer to their already long list of trophies. On a night raid they found it outside Tripoli harbour, launched torpedoes at it, and destroyed it. In addition, on the same raid a large merchant ship was hit by bombs.

R.A.F. bombers had to search diligently before they found the synthetic rubber works at Huls, carefully hidden in the forests of the Rhineland; but Wellingtons and Hampdens planted their bombs among the buildings with good results.

ENEMY AIR LOSSES TO SEPT. 6th

	Over G.B.	Over Continent	Middle East
Aug. 31	0	1	0
Sept. 1	2	0	0
" 2	0	2	0
" 3	0	0	0
" 4	0	11	6
" 5	1	0	11
" 6	0	0	1
	3	14	18

Totals: Northern Area, 5,297; Middle East, over 2,093.



THAT SINKING FEELING : Three Beauforts of Coastal Command, armed with torpedoes, go off to look for enemy shipping.

AFTER TWO YEARS OF WAR

The Part Played by Air Power

By MAJOR F. A. de V. ROBERTSON, V.D.

SEPTEMBER 3rd sent our thoughts back to the same day in 1940 and in 1939. It seems a long time since that Sunday morning in 1939 when the sirens sounded just before noon and alarmed many people in church. There is more profit in thinking of the same date in 1940, when we were in the thick of the Battle of Britain. Strangely enough, that anniversary was not marked by any outstanding fighting. The R.A.F. fighters only shot down 25 enemy aircraft that day and lost 15 of their own machines, though eight of the pilots escaped. But the newspapers that morning recorded that 65 German machines bit the dust on the day before, with a loss of 20 British fighters, from which 12 of the pilots lived to fight again. The "alerts" sounded frequently every day in that autumn, but the spirit of the country was high and everyone felt confident that the Spitfires and Hurricanes had got the measure of the enemy. Their belief was well founded, and in due course the dangerous day raids were given up. The night raids which followed were brutal, but they did not threaten Great Britain with defeat.

Next came the so-called Battle of the Atlantic, when the second crop of U-boats crept out of their shells and made a determined attempt to starve Britain by interrupting the supplies from the American continent. Focke-Wulf Kuriers helped by reporting the whereabouts of the convoys, and now and then by bombing ships. The heavy bombers of the *Luftwaffe* concentrated their attention on the ports at which the ships would naturally dock, and tried to destroy their facilities for unloading the cargoes. The defence of the convoys was mainly a concern of the Royal Navy, but the R.A.F. helped by bombing the bases of the U-boats and the Kuriers and by sending out patrols of flying boats and Hudsons to watch for periscopes and to engage the Focke-Wulfs. The usefulness of the air patrol is not to be judged by the number of U-boats sunk by air bombs, or by the 256 attacks made on them. To sight a periscope and give the news to the naval escorts is of even more far-reaching importance.

Bombing and Counter-bombing

In the meantime it had been noted that the number of night raiders shot down over Great Britain was slowly but steadily on the increase, and presently the secret of radio-location was made known in general terms to the world. It is believed that the Germans are at work on a similar device, but that they are still some distance behind us. Another way of reducing the numbers of *Luftwaffe* bombers was to send night fighters over the German aerodromes and to shoot down the raiders as they came in.

As the year went on the strength of the R.A.F. was increased, and, whereas it had all along been heavily raiding military targets in enemy-occupied territory by night, it began to indulge in day raiding also. In some quarters one constantly reads the phrase, "The initiative has passed to the R.A.F." It is a misleading phrase, for in a bombing match both sides hold the initiative. During the summer months the *Luftwaffe* has been busy on the eastern front; otherwise there is no reason to suppose that it would not have continued its night bombing programme against Great Britain. By day the R.A.F. is demonstrating that it can do what the Germans tried to do last summer, but the two sets of operations are not on all fours. The Germans tried to use air bombardment as a preparation for an invasion; the R.A.F. has a more modest object. For the most part the R.A.F. daylight sweeps are made within the range of our short-range fighters, so that strong escorts are possible. There is evidence that they have forced the Germans to withdraw a useful number of their own fighters from the Russian front.

Occasionally the Bomber Command has decided on strong daylight raids to attack objectives outside the range of the Hurricanes and Spitfires. One such attack was made on the German warships *Scharnhorst*, *Gneisenau*, and *Prinz Eugen* when the first named had steamed away from Brest and had been located at La Pallice. All three vessels have been prevented from returning to the Atlantic.

Attacks on Brest, Kiel, and other ports are instances of the help which the R.A.F. Bomber Command gives to the Navy in the Battle of the Atlantic. Raids on the invasion ports are help for the Army. When there is no special demand of that sort, the Bomber Command works on a carefully thought-out programme of attacks on German production centres, chiefly in the Ruhr, and on German communications by land and sea.

During much of the year the centre of interest has been in the Middle East. The Italians had boasted that Malta could be made quite untenable by their bombers, and at first it was very difficult to arrange for its air defence. Gradually those difficulties have been overcome, and the people of the island have borne an infinity of air raids with a fortitude which has equalled that of the Londoners. The Mediterranean Fleet certainly cannot make Malta its headquarters, but, none the less, the damaged carrier, H.M.S. *Illustrious*, was there patched up, in spite of the enemy's attempts to finish her off, and was able to steam away to Alexandria.

Ups and Downs in Africa

In Africa the year has seen both ups and downs. Last September the Italians had occupied British Somaliland and Sollum on the western frontier of Egypt. In the interval Cyrenaica has been won and lost by us, but the large Italian army which threatened Egypt is no longer in being. Italian Somaliland has been conquered by us, British Somaliland has been regained, Eritrea is now in our hands, and the Negus Haile Selassie sits once more on his throne in Addis Ababa. In all those campaigns the R.A.F., the South African Air Force and the Rhodesian Air Force have played a full part.

When we come to recall events in Greece and Crete we are not so happy. Everybody is agreed that the British Army and the Royal Navy did everything that could be expected of them, but air support was lacking. No slur can be cast on the honour of the squadrons which were in Greece, for they, too, did all that British airmen could do—but there were not enough of them. The full story has not yet been told, and so there is little point in trying to draw morals from our incomplete knowledge. We merely hope that the same thing will not happen again.

For the Fleet Air Arm there is nothing but praise. It has done gloriously on many occasions, and it has enabled a comparatively slow British fleet to inflict damage on a faster flying enemy. In particular, the Fleet Air Arm has proved the value of the air-borne torpedo—a point much discussed before the war. At Taranto, at Matapan, and in the hunt of the *Bismarck*, the F.A.A. scored heavily.

We enter the third year of the war with solid grounds for high hopes. American help is reaching us in increasing quantities. The German army has been held in a way which few had dared to hope for by the Russians. The Allies have entrenched themselves in a line from the Mediterranean through Syria, Iraq and Iran, thus blocking one route on which Hitler may have set covetous eyes, and securing one by which help can be sent to the Russians. The *Luftwaffe* has certainly suffered heavily at the hands of the Red Air Fleet, while the Royal Air Force continues to grow in numbers and to improve in the quality of its machines. It cannot improve in spirit.

HERE AND THERE

Canadiolocators

MR. C. D. HOWE, Minister of Munitions and Supply, announced that radiolocators are already installed and working on Canada's east and west coasts.

Shut Down

CANADA'S oldest commercial airfield, Western Airport, Toronto, closed at the end of July after being in continuous service since 1910. First flights were made there by Count Jacques de Lesseps in 1910. The airport has seen many types of aircraft since that first model. A growing residential area finally forced the old airport to close. A farm couple, in their eighties, after living within sight of the field all these years and witnessing the first flight, finally decided to fly on the last day the field was open. They wished they had started earlier!

Plastic Aircraft

WORK continues on the application of plastics to aircraft, though not nearly as fast as it would have if peace had persisted. Latest news is that an Avro Anson with a fuselage of moulded plywood flew in Canada in August. Two such fuselages have been sent to Ottawa from Bendix Field, New Jersey, where they were manufactured by the Aircraft Research Corporation under the process invented by E. L. Vidal.

The Dominion Government last year obtained exclusive rights to the use of the process in Canada. A Government-owned plant in the Belleville, Ontario, area is expected to go into production on plastic plane parts later in the year, it has been stated by the Department of Munitions and Supply. The Vidal material is a moulded plywood bonded with a phenolic resin. This method probably has the advantages of rapid production and decreased cost as compared with present methods.

P/O. C. B. Massy and his bride Miss Pamela Scott-Paine. Miss Scott-Paine is the daughter of Mr. Victor Scott-Paine of Vickers-Armstrongs, Ltd., and niece of Hubert (Power Boat) Scott-Paine.

ENTERPRISING SQUADRON: No. 90 (Woolwich) Squadron of the A.T.C. employs a trailer caravan for recruiting purposes. It has proved very successful.

Moulded Plywood Floats

FLOATS made of plastic-bonded plywood for use on light aircraft have been approved by the Civil Aeronautics Authority in U.S.A. It is likely that they will be considerably cheaper than aluminium alloy floats.

Stuka Stalker

AN anti-aircraft weapon which appears to have great possibilities against dive-bombers has been invented by a young Canadian. Long interested in guns of all descriptions, A. R. J. Hilson, of Hamilton, the inventor, tied for the King's Prize in 1927 at Bisley. He describes his invention thus: the projectile is an expanding web of special lightweight material of tensile strength sufficiently high to destroy any aircraft with which it comes into contact. Since in accurate dive-bombing bombs must be released at about 1,500ft. or lower, the initial discharge from the gun would carry the web far enough to envelop and destroy attacking aircraft. For firing at more distant aircraft, charges from rockets attached to the web could increase the effective range to several thousand yards.

The web expands quickly and can be adjusted to reach its diameter anywhere from 100 to 700 yards. The National Research Council at Ottawa and military authorities have shown great interest in the weapon, which is said to be suitable for mounting on ships, tanks and even aircraft.

More American Salaries

FOLLOWING the figures which were published in our issue of September 4th of the salaries of some of the big men in the aircraft industry in U.S.A., there are now some additional ones. These also are converted at the rate of $4.03 to £1.

In the Douglas Aircraft Co., during 1940, Donald W. Douglas, president, received £18,600; Carl Cover, vice-president and general manager, £9,100; V. E. Bertrandias, vice-president and sales representative, £13,600; S. R. Smith, special sales counsel, £9,900; M. E. Wagner, sales agent, £41,300. The Republic Aviation Corporation paid its president, Wallace W. Kellett, £8,900; Joseph L. McClane, vice-president, £6,300; Harrison W. Flickinger, £4,400; and Bleekley, Platt and Walker, £6,700 in legal fees.

Mr. Wagner, at the head of this list with £41,300, just beats Mr. J. H. Kindelberger, president of North American, who headed our previous list with £41,100.

SOMETHING TO FALL BACK ON: Forming the fighter pilot's cushion while in the machine is the seat-type parachute pack, and, nearest the body, the one-man collapsible dinghy in its case.

HERE AND THERE

Air Mail Payments

THE Civil Aeronautics Board has examined the cost of transporting mail by air in the case of American Airlines and has recommended that the company be paid at the rate of 9.5 cents per scheduled aeroplane-mile flown with mail. The Board also recommends that the one rate be applied to the whole of the company's system, not different rates for different routes. Up to 300 lb. of mail must be carried per trip. (This rate is roughly fivepence per mile. Machines such as the Douglas DC-3 cost about 70 or 80 cents per mile, 35 to 40 pence, to run, including all operating costs, depreciation, office overheads and interest on capital. It therefore appears that American Airlines must be taking about 30 to 35 pence per mile for passengers and freight.)

Monopolies, Hands Off!

SENATOR McBRIDE, the Australian Minister of Munitions, is reported by *Financial News* as saying that no world aluminium monopoly will be allowed to grab Australia's new aluminium industry. Rolling and extrusion plants are reported to be already in existence and the establishment of the industry is being expedited by the import of some bauxite. There are large depots of this mineral in New South Wales, Victoria and Queensland, but up till the start of the war there had been little reason to develop them.

The decision to produce aluminium in Australia was taken after the outbreak of war, when it became evident that the import of this essential metal for the aircraft industry would be very much restricted. Australia has a chance to start the industry with a clean slate as no aluminium has previously been produced there. Judging by the Minister's statement, it seems that at least some people are aware of the danger of letting an important industry get into the hands of a private monopoly. This danger was well illustrated by the account on page 347 of our issue of May 15th of the group of companies in U.S.A. which were indicted before a Federal grand jury and accused of restricting magnesium output, so become indirectly responsible for Germany's production being 400 per cent. more than that of the United States.

U.S. NAVY PATROL : Although we gave them up after the 1914-18 war, the Americans still employ blimps for patrol over the Western Atlantic. The photographs above show an observer seated in the control cabin studying a merchantman, and three blimps on parade at Lakehurst Naval Air Base.

Hunting the Mesotron

THE University of Chicago is using an airliner of the United Air Lines fleet to carry two of its physicists to a height of 30,000 feet just after dawn for the purpose of studying cosmic rays and other high-altitude phenomena, reports *Aviation*. The expedition ascends with a 700lb. magnet, batteries, a Wilson cloud chamber and "geiger counters," and is on the look-out for the mysterious cosmic particles, among which is the mesotron.

Accident Rate

THE accident rate for the airlines in U.S.A. is again commendably low for the year 1940 with one passenger death per 36 million passenger-miles flown. Though this rate is not quite so good as that for 1939, which was 44 million, it is much lower than the rates for the years 1936, 1937 and 1938, which were 10, 10 and 19 million respectively.

The total deaths for 1940 were only 38, three of these being crew. Considering that over 119 million aeroplane-miles and 1,265 million passenger-miles were flown, it is evident that air transport has achieved a remarkable record of safety. There were 53 accidents, but only three of these were fatal ones.

Air Mail to Northern Ireland

FROM Monday, September 1st, an air mail service for letters, letter packets and postcards has been operating between Great Britain and Northern Ireland. Correspondence must be prepaid in addition to the ordinary inland postage rate, with a special air fee of 3d. for each 8 oz. for letters or letter packets and 3d. each for postcards. A blue air mail label should be affixed (or the words "Air Mail" written) in the top left-hand corner of the address side. Correspondence may be posted in any letter box.

The advantages of this service over transmission by the normal routes will vary according to the time and place of posting, but will be between 6 and 24 hours. Generally, letters posted early in the day in England, Scotland and Wales will secure no advantage. Letters for Northern Ireland posted in London too late for the collections in the head districts at noon, and in the sub-districts at 10.30 a.m., will secure about 24 hours' acceleration. The benefit of the service from Northern Ireland will apply mainly to letters posted early in the day for London and the Midland and Southern Counties. The new air mail is not available for correspondence to Eire.

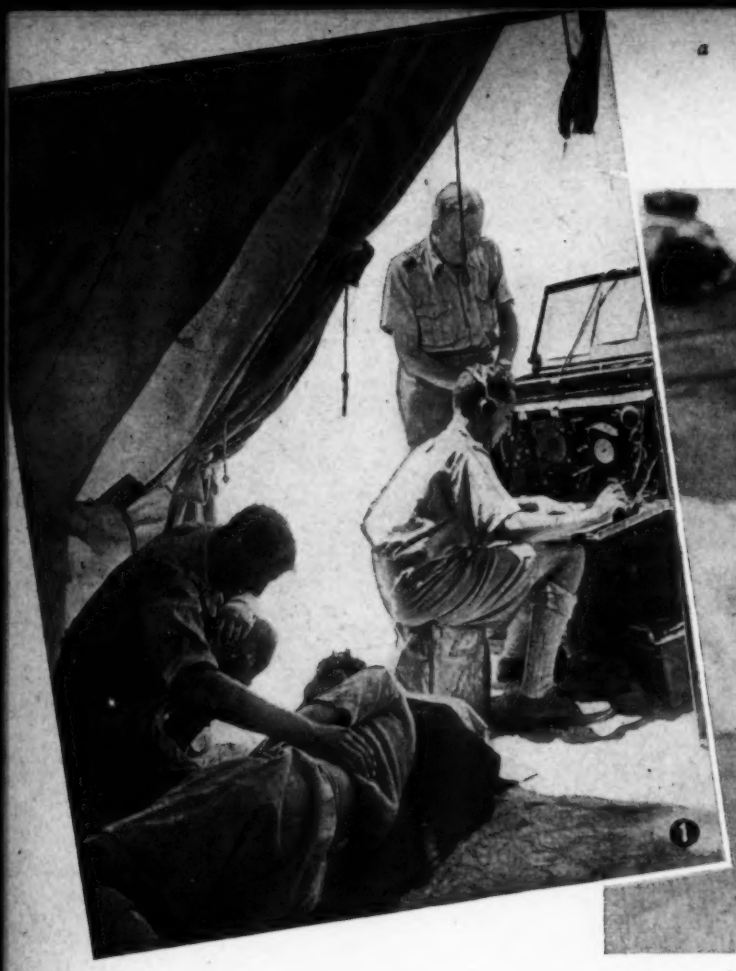
THE FINISHING TOUCH : Reindeer grazing in Finland with a Dornier Do 17 for company.

AVRO

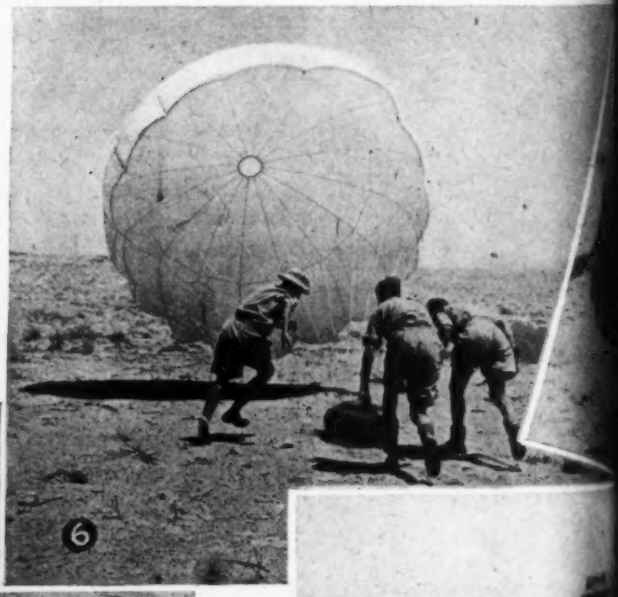
A. V. ROE & CO. LIMITED

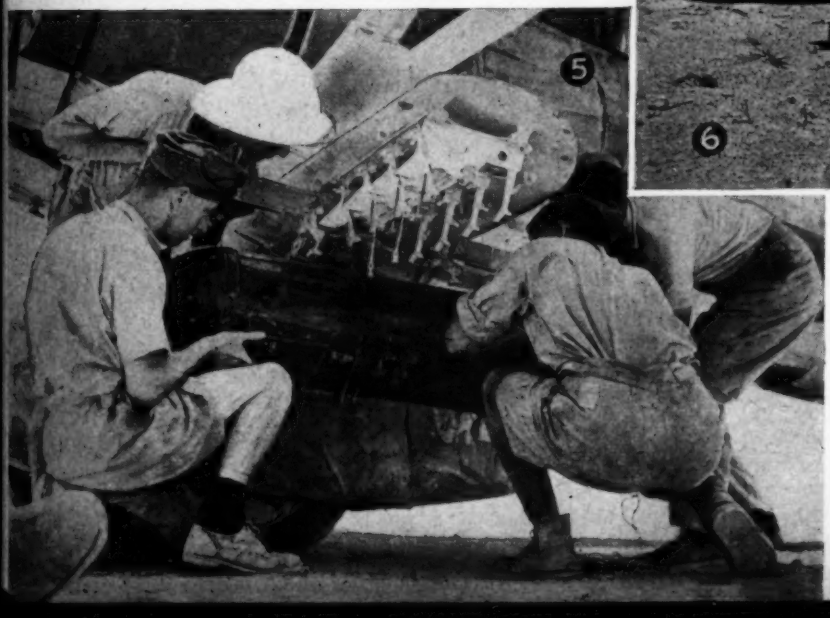
Branch of the Hawker Siddeley Aircraft Co. Ltd.

COMMU



(1) An airman at an isolated desert outpost was bitten by a snake and a wireless message sent to Group H.Q. asking for advice. (2) The medical officer at H.Q. immediately prepared anti-snake-bite serum and an hypodermic syringe which, with written instructions, were (3) packed ready for delivery by air. (4) A motor cyclist takes the package to a Communications Flight, where a machine is standing by ready to take off. (5) After careful packing the parachute container is attached to the bomb-carrying stub wings of a Lysander. (6) On arrival at the scene of the trouble the container is dropped and (7) hurriedly picked up by the waiting outpost. (8) Unpacking the box reveals everything to be intact. The instructions are followed and (9) the injection is made in the arm of the prostrate airman.

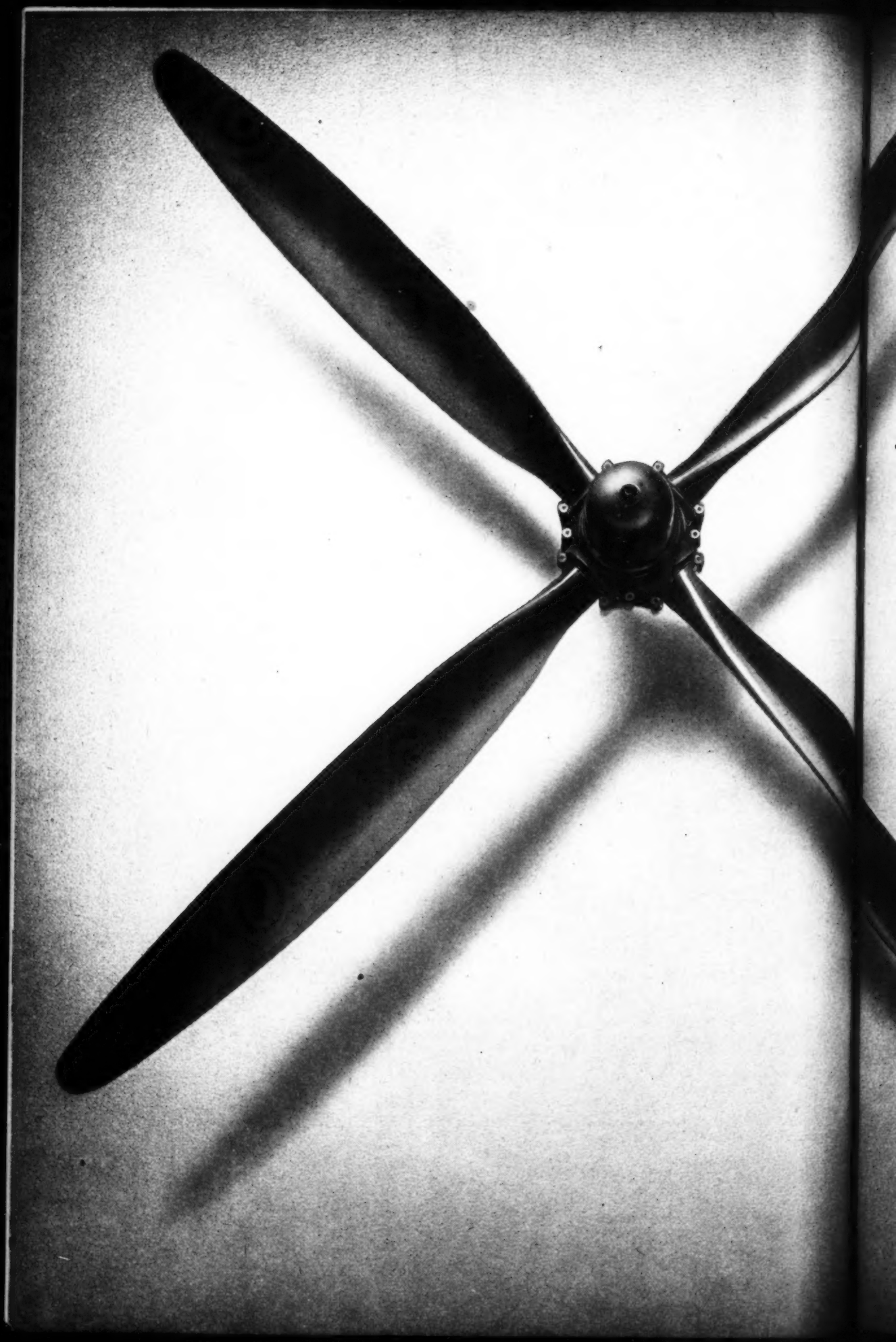


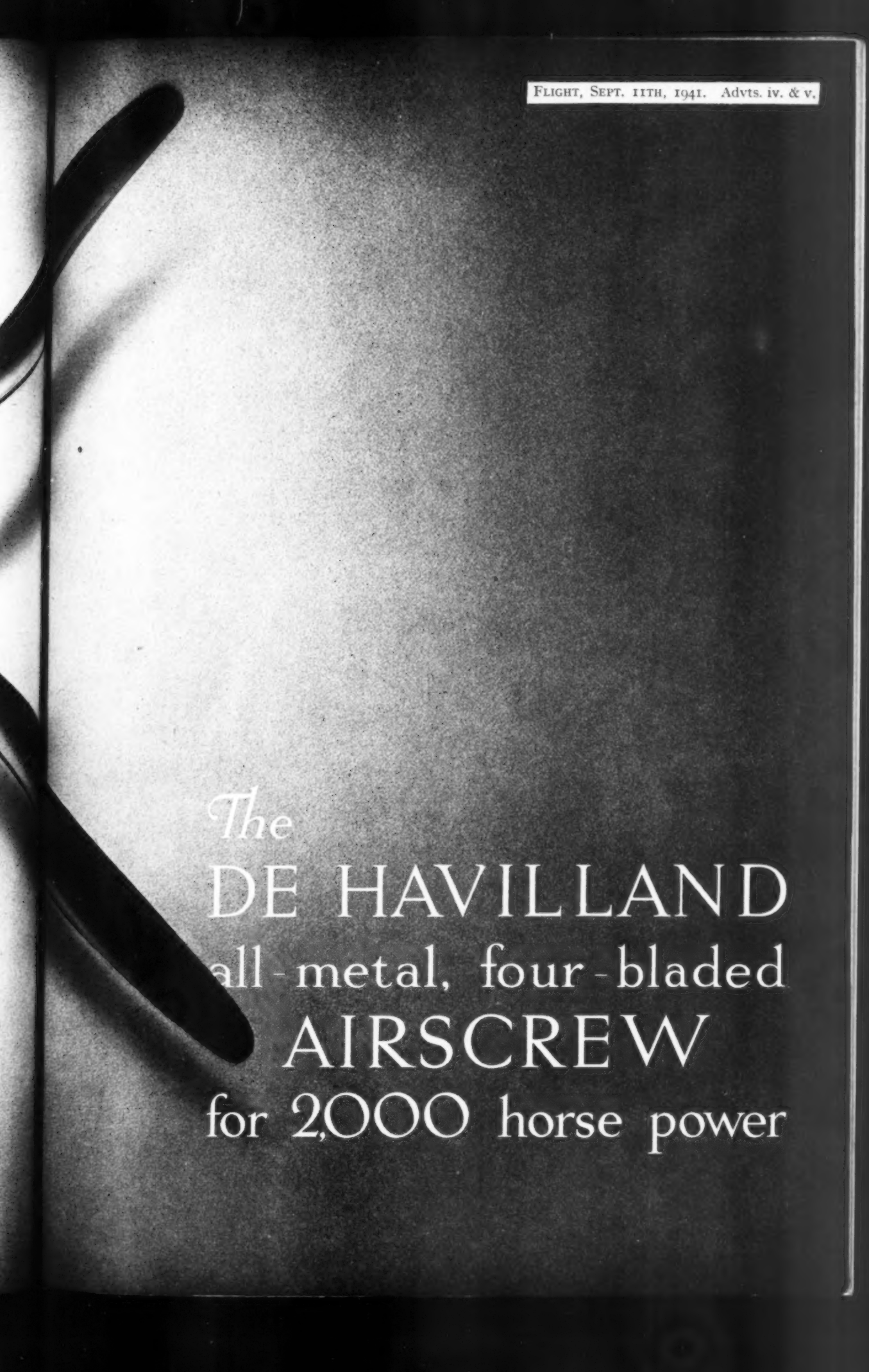


...UCATIONS FLIGHT

A Story in Pictures of One of the Many and Varied Jobs Tackled in the Ordinary Course of Duty

A COMMUNICATIONS FLIGHT must be ready at any hour of the day or night to take on any one of a thousand different jobs. Admirals, Generals and Air Officers all require transport for long journeys where time is a consideration. Supplies must be taken to isolated detachments and urgent spare parts for aircraft or military vehicles are often transported by air. This sequence of pictures shows the manner in which a Communications Flight in the Western Desert handled a request for anti-snake-bite serum from a detachment which had no medical officer of its own.

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FRIEND OR FOE?

Single-tail Design of the Blenheim IV and Ju 88

THESE two medium-sized bombers make a particularly good pair from the point of view of tail design, and the spotter's job of differentiating between them from this angle is by no means easy.

There is, in fact, a striking similarity between their fins and rudders, so it is fortunate that when a decent side view is presented—even at a fair distance—the observer will not be compelled to rely upon detecting the slight difference between their respective vertical tail surfaces, but will, almost inevitably, get an informative look at their very different noses.

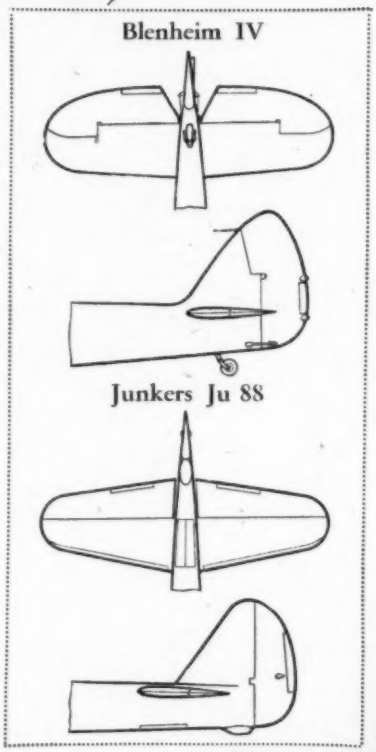
Where the two tail assemblies do differ appreciably, however, is in the position and plan of their respective tailplanes. Both are mounted slightly below the top line of the fuselage, but that of the Blenheim is set with the root of its leading-edge level with the base of the fin's leading-edge, whereas that of the Ju 88 is set forward of this position. This also affects the plan of the tailplane and is responsible for a difference sufficiently apparent to be a useful aid in establishing identity. It has already been said that the rudders of both these bombers are strikingly similar. They are of the type which continues down to the lower extremity of the fuselage proper, in contrast to the type which sits atop the tail of the fuselage and shares a common base-line with the fin to which it is attached. Now the position of the Blenheim tailplane means that its elevators project rearwards on either side of the rudder, where they have to be cut away at an angle to permit rudder movement. This results in the "bite" so often seen in the centre of the trailing-edge of many tailplanes. But in the case of the Ju 88, the forward setting of the tailplane in relation to the vertical surfaces leaves the elevators clear of the rudder and so no "bite" is necessary.

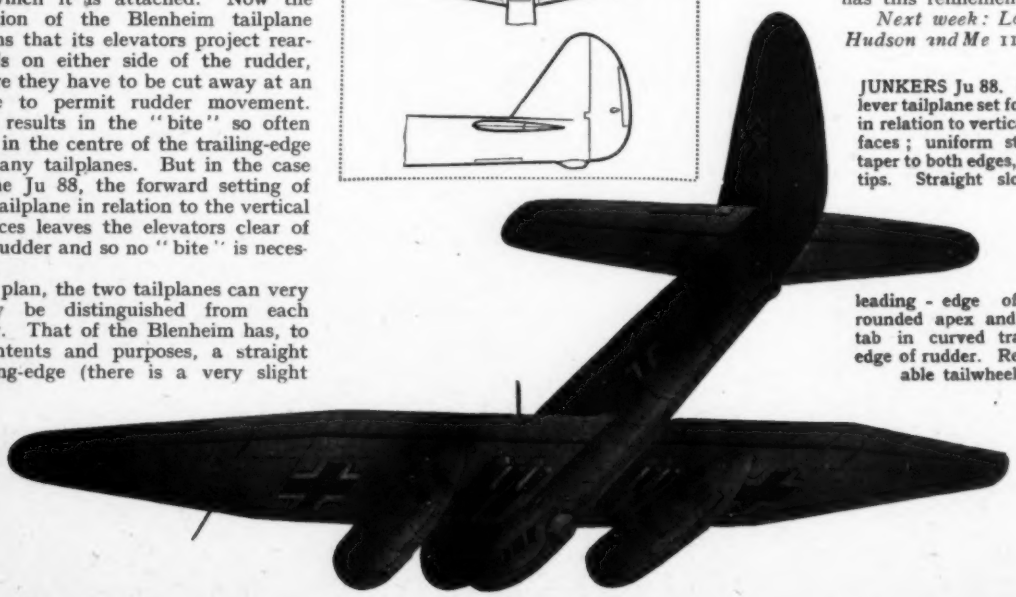
In plan, the two tailplanes can very easily be distinguished from each other. That of the Blenheim has, to all intents and purposes, a straight leading-edge (there is a very slight taper but it is almost imperceptible), well-rounded tips and curved elevators. The Ju 88's tailplane, however, has a pronounced and uniform straight taper to leading- and trailing-edges and comparatively small rounded tips.

Such small differences as exist between the fins and rudders of the two machines, though they may often be impossible to discern in actual practice, must be mentioned. The leading-edge of the Blenheim makes a slight convex curve, but that of the Ju 88 is a perfectly straight slope. The apex of the Blenheim rudder is almost small enough to be called a point, whereas that of the German machine is appreciably broader. Trimming tabs are inset in both cases, but on the Blenheim will be seen two small lights, one above, the other immediately below the tab, which are not fitted to the Ju 88. Incidentally, certain other Blenheim models have only one light below the tab, but the characteristic Bristol fin and rudder are identical in outline on all types, including Beaufighter and Beaufort. The Blenheim IV tailwheel is not retractable, but the latest Ju 88 now has this refinement.

Next week: Lockheed Hudson and Me 110.

BRISTOL BLENHEIM IV. Cantilever tailplane set level with base of fin; imperceptible taper to leading-edge, rounded tips and curved trailing-edge with "bite." Convex curve to leading-edge of fin, small apex and two lights on trailing-edge of rudder. Fixed tailwheel.



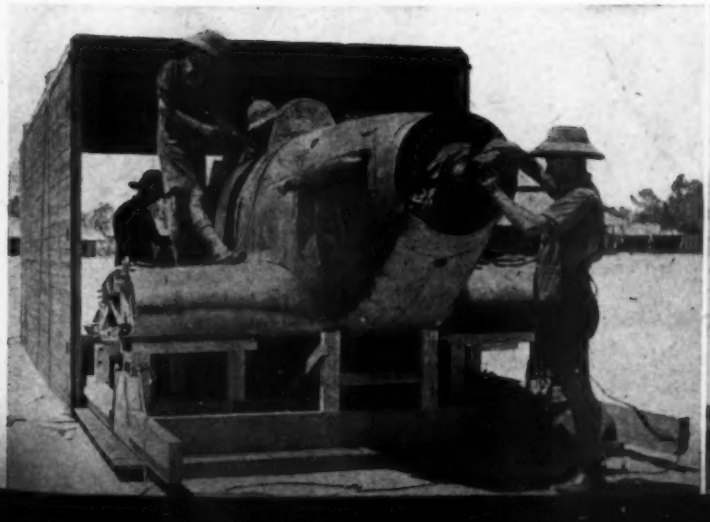


JUNKERS Ju 88. Cantilever tailplane set forward in relation to vertical surfaces; uniform straight taper to both edges, round tips. Straight slope to leading-edge of fin, rounded apex and inset tab in curved trailing-edge of rudder. Retractable tailwheel.

FIGHTERS FOR THE MIDDLE EAST

Photographs of Hurricanes and Tomahawks Being Erected at an R.A.F. Maintenance Unit

Top left is a Tomahawk fuselage being lifted by a mobile crane from its special knock-down crate. *Centre left* shows a three-bladed Rotol airscrew being carried away after unpacking. *Bottom* are fore and aft views of a Hurricane in the process of being uncrated. Hurricanes arrive in single cases while To..ahawks have separate crates for the fuselage and wings. *Above right* is a Maintenance Unit pilot climbing out of a Tomahawk after a test flight.



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PRESSURE INJECTION

A Description of the Stromberg System Widely Used on American Aircraft

By CHARLES A. FISHER, A.M.I.Mech.E., M.I.A.E.

IN a previous article on fuel injection (*Flight*, August 21st) mention was made of the pressure injection system developed by Bendix Aviation Corporation, South Bend, Ind., U.S.A., and embodied in the Stromberg injection carburettor now fitted to large numbers of American aircraft-of-war. In the article referred to the pros and cons of the various injection systems were compared with those of the orthodox aircraft carburettor, and the reader who is sufficiently interested is advised to refer to that issue. Space considerations preclude the recapitulation of the various factors involved, and the present discussion is intended to deal only with the layout and operation of the Stromberg injection system. We should, however, preface our remarks with a few notes on the operative characteristics of the design. Together with cylinder injection systems, such as that employed on German aircraft, the Stromberg possesses the following qualities:—

(1) Freedom from icing-up, since no fuel whatever passes the throttles.

(2) Freedom from cutting-out during any manœuvre of the aircraft, including negative G, owing to the fuel system from fuel pump to injection nozzle being always full and under pressure.

(3) Freedom from vapour lock to higher altitudes for the same reason as (2).

(4) Efficient atomisation of the fuel, owing to pressure discharge.

In addition, the injection carburettor can claim the following:—

(5) Lower airflow loss through carburettor (venturis may be larger since no fuel metering suction is necessary), while the presence of fuel in the supercharger obviously maintains normal pressure ratio of the latter.

(6) Ease and simplicity of maintenance service testing.

Although a newcomer to the European field of carburation, the Bendix-Stromberg has been in large-scale production in the United States for about three years, and is standardised on a large proportion of the American aircraft now arriving in this country.

If there is one fact more than another which intrigues us in the review of fuel injection in general it is that, although the problem in all its branches (including cylinder injection *à la* the Germans) has been the subject of considerable research by various concerns in the States, it is fuel injection into the supercharger entry and not into the cylinder which has emerged successfully and passed into production.

Briefly, the Stromberg system consists of metering the air alone through a fairly orthodox arrangement of double venturi, and imposing the resulting pressure differential across a diaphragm assembly which controls the flow of fuel into the carburettor. From the fuel pump to the carburettor the fuel is under the initial pressure of 15 lb. per sq. in., and after being metered by the jet system it is injected into any chosen position in the blower entry through a discharge nozzle or nozzles of any chosen shape or type, at a constant pressure of about 5 lb. per sq. in. In some cases the point of injection chosen is directly into the eye of the blower, while in others a diffuser bar bearing a number of holes is arranged across the airstream tract between carburettor and blower. In all cases the nozzle location and type is worked out experimentally to suit the distribution characteristics of the engine concerned, and the ability to do this is a most valuable feature.

The carburettor embodies automatic correction for altitude, together with automatic mixture enrichment for high power, and the usual manual mixture controls, i.e., *Idle Cut-Off, Auto-Lean, Auto-Rich* and *Full Emergency Rich*. Thus the system is one of pressure injection pure and simple, and although, for want of a better name, the assembly is known as the pressure or injection carburettor, it is quite unlike the orthodox aeroplane carburettor in its method of functioning. Another point of interest is that the mixture ratio demanded at any moment is completely unaffected by throttle position, since the carburettor responds only to changes in mass airflow. Similarly, the carburettor could be flown upside down all day without any change in functioning (if the fuel supply system could be arranged to deliver fuel satisfactorily). In other words, the carburettor does not know what the throttle is doing or whether the aircraft is right-side-up or not.

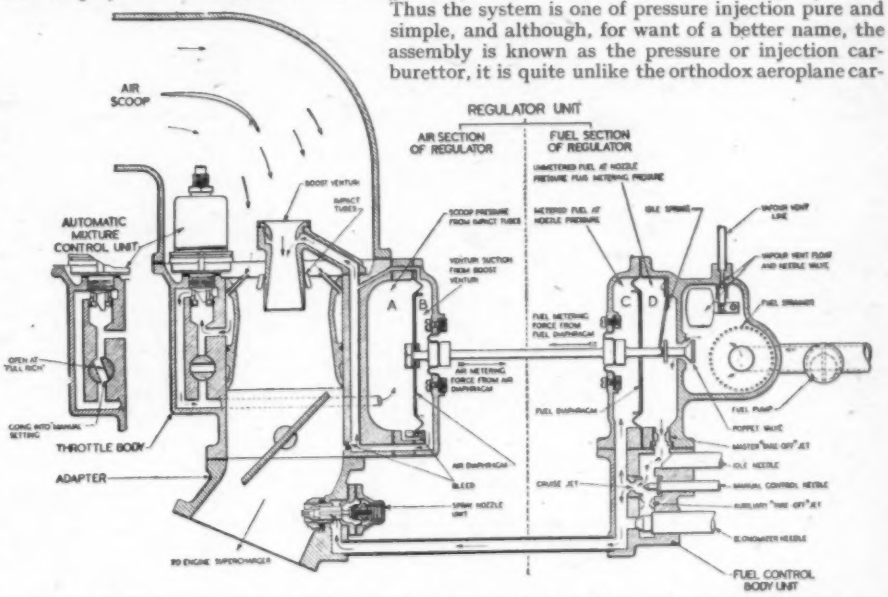


Fig. 1. Diagrammatic section of the Stromberg carburettor, which comprises four main parts: the throttle body, the altitude control unit, the regulator unit, and the fuel control body.

The elementary functioning of the carburettor will best be understood by study of the illustration in Fig. 1. The assembly may be divided broadly into four parts:—

The Throttle Body, which comprises the venturi system and throttles. Attached to the throttle body is

The Altitude Control Unit. This is a self-contained assembly comprising a capsule and needle valve, and may easily be unscrewed and withdrawn for inspection.

The Regulator Unit. This assembly contains the air and fuel diaphragms, which are the chief sources of fuel control within the carburettor.

The Fuel Control Body, which contains the jet system

PRESSURE INJECTION

which meters the fuel, together with the mechanism of the manual mixture control.

Let us first examine the airflow side of the diagram, Fig. 1. On the left we have the throttle body, which contains the venturis and orthodox-type throttles. These throttles do nothing except control the airflow, and there are no critical "throttle-edge" idle or progression devices, since the idle control is incorporated in the main carburettor. Those familiar with Stromberg carburettors will recognise the arrangement of double venturi, but here the venturis meter air only. *No fuel passes through the venturi or throttle body.* The pressure of the incoming air through the airscoop is recorded by a number of small impact tubes, so arranged on the upstream end of the large venturi that they face the airstream. The suction in the small or "boost" venturis is taken from an annular channel round the neck of the latter, the edge of this pointing downstream. This arrangement is, in effect, an airflow meter, recording mass airflow; and, since there is no discharge of fuel at this point to upset the venturi astion, its calibration is extremely accurate. In the research work on the carburettor during development it was found that this layout permits more than twice as large a metering head per unit of resistance as could be obtained in previous carburettor systems.

Turning again to the diagram, the suction from the small venturi is taken through the passage shown to the right-hand side of the air diaphragm, known as chamber B. The airscoop pressure from the impact tubes is likewise carried (via the altitude control needle valve) to the left-hand chamber, called chamber A. The air diaphragm is thus subject to the pressure differential across the venturi system, and so will be pulled to the right as the airflow is increased, and vice versa.

Turning now to the fuel section of the regulator (on the right of the illustration) there is another diaphragm chamber, the fuel diaphragm being connected to the air diaphragm by a rod, so that both must move together. At the extreme right-hand end of this coupling rod is one of the most important items in the carburettor, the poppet valve which controls the main flow of fuel into the carburettor.

Let us now follow the passage of fuel through the carburettor. Fuel enters the strainer chamber at a pressure of approximately 15 lb. per sq. in. from the fuel pump. It then passes the poppet valve (which is never quite closed, as will be explained later), and so into the chamber on the right, called chamber D. Before passing into the next chamber (chamber C) the fuel must first pass through the Fuel Control Body, where it is metered by the jet system as shown. Chamber C, it will be observed, is in direct communication with the discharge nozzle, and the fuel therein is *metered* fuel, as against the *unmetered* fuel in chamber D.

We have seen that the pressure differential across the venturi, acting upon the air diaphragm, exerts a force to the right, and this is known as the *air metering force*. The greater the airflow through the carburettor the greater this

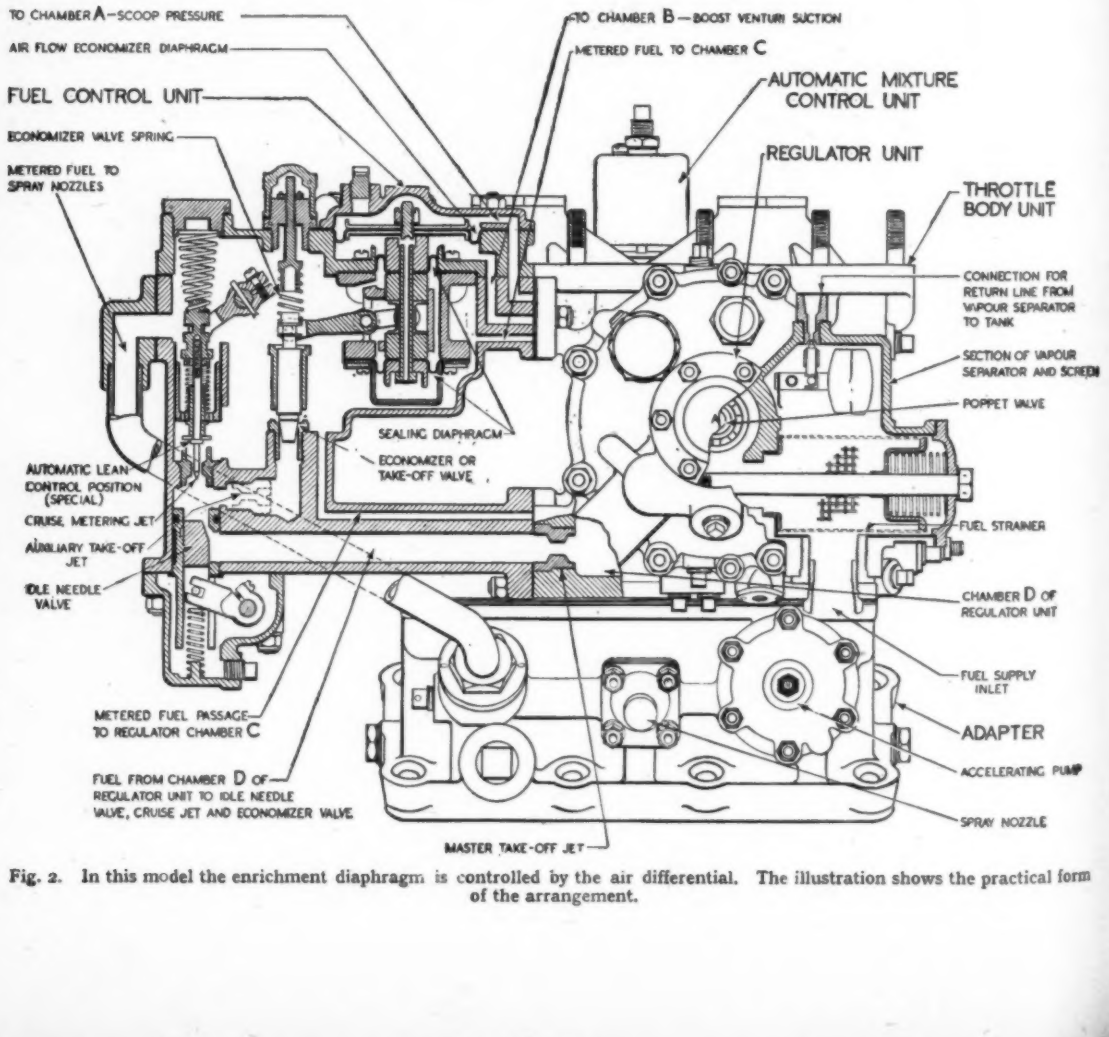

TO CHAMBER A—SCOOP PRESSURE
AIR FLOW ECONOMIZER DIAPHRAGM
FUEL CONTROL UNIT
ECONOMIZER VALVE SPRING
METERED FUEL TO SPRAY NOZZLES
TO CHAMBER B—BOOST VENTURI SUCTION
METERED FUEL TO CHAMBER C
AUTOMATIC MIXTURE CONTROL UNIT
REGULATOR UNIT
THROTTLE BODY UNIT
CONNECTION FOR RETURN LINE FROM VAPOUR SEPARATOR TO TANK
SECTION OF VAPOUR SEPARATOR AND SCREEN
POPPET VALVE
SEALING DIAPHRAGM
ECONOMIZER OR TAKE-OFF VALVE
AUTOMATIC LEAN CONTROL POSITION (SPECIAL)
CRUISE METERING JET
AUXILIARY TAKE-OFF JET
IDLE NEEDLE VALVE
FUEL STRAINER
CHAMBER D OF REGULATOR UNIT
FUEL SUPPLY INLET
ADAPTER
ACCELERATING PUMP
SPRAY NOZZLE
METERED FUEL PASSAGE TO REGULATOR CHAMBER C
FUEL FROM CHAMBER D OF REGULATOR UNIT TO IDLE NEEDLE VALVE, CRUISE JET AND ECONOMIZER VALVE
MASTER TAKE-OFF JET

Fig. 2. In this model the enrichment diaphragm is controlled by the air differential. The illustration shows the practical form of the arrangement.

PRESSURE INJECTION

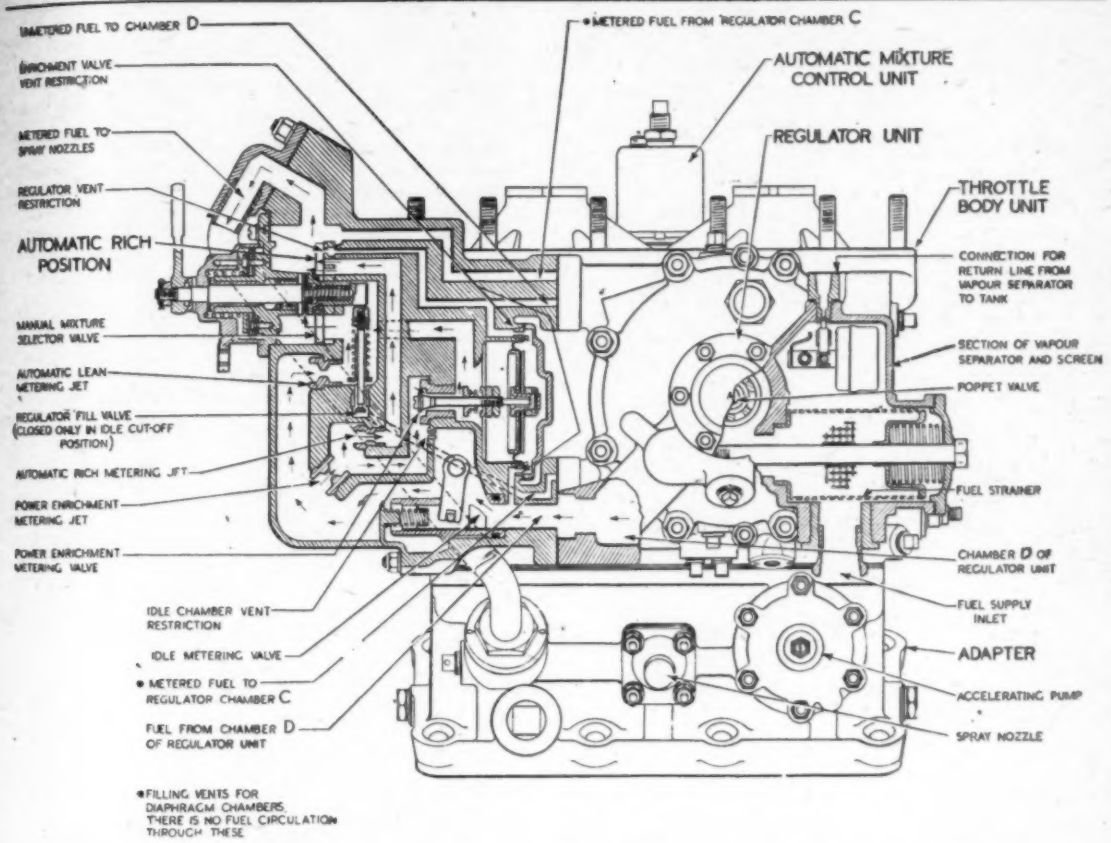

UNMETERED FUEL TO CHAMBER D
ENRICHMENT VALVE VENT RESTRICTION
METERED FUEL TO SPRAY NOZZLES
REGULATOR VENT RESTRICTION
AUTOMATIC RICH POSITION
MANUAL MIXTURE SELECTOR VALVE
AUTOMATIC LEAN METERING JET
REGULATOR FILL VALVE (CLOSED ONLY IN IDLE CUT-OFF POSITION)
AUTOMATIC RICH METERING JET
POWER ENRICHMENT METERING JET
POWER ENRICHMENT METERING VALVE
IDLE CHAMBER VENT RESTRICTION
IDLE METERING VALVE
* METERED FUEL TO REGULATOR CHAMBER C
FUEL FROM CHAMBER D OF REGULATOR UNIT
* FILLING VENTS FOR DIAPHRAGM CHAMBERS. THERE IS NO FUEL CIRCULATION THROUGH THESE
* METERED FUEL FROM REGULATOR CHAMBER C
AUTOMATIC MIXTURE CONTROL UNIT
REGULATOR UNIT
THROTTLE BODY UNIT
CONNECTION FOR RETURN LINE FROM VAPOUR SEPARATOR TO TANK
SECTION OF VAPOUR SEPARATOR AND SCREEN
POPPET VALVE
FUEL STRAINER
CHAMBER D OF REGULATOR UNIT
FUEL SUPPLY INLET
ADAPTER
ACCELERATING PUMP
SPRAY NOZZLE

Fig. 3. A different model from that shown in Fig. 2. The enrichment diaphragm is controlled by the fuel differential. The valve which gives the manual mixture positions is of the rotary disc type.

force becomes, and the more the air diaphragm will move to the right, so opening the fuel poppet valve still farther and admitting more fuel. The system is kept in balance by the fuel diaphragm, which exerts a force in the opposite direction, known as the *fuel metering force*. This force is the difference between the unmetered and the metered fuel. The pressure of the metered fuel being kept constant at 5 lb. per sq. in., the pressure differential across the air and fuel diaphragms is always the same, but acting in opposite directions, since the air metering force will always be balanced by the fuel metering force. Additional small diaphragms are used in both chambers for sealing and balancing.

Owing to the possibility of inertia in the diaphragm assembly at very small airflow, a light spring is arranged to hold the poppet valve from seating on idle. This introduces a rich bias when idling, which is corrected as required by an external idle mixture adjustment.

The constant-pressure discharge nozzle is a simple arrangement, and its operation will be readily grasped from the illustration. The spring permits the valve to open at approximately 5 lb. per sq. in., and when the pressure tends to increase as the flow becomes greater, the diaphragm compresses the spring and opens the valve farther, maintaining the pressure constant.

The fuel-control body and jet system assembly are shown diagrammatically at the bottom right-hand corner of Fig. 1. There are actually several arrangements of jet system which differ only slightly, but for the purposes of this description we will deal only with that illustrated in the diagram. From chamber D the fuel passes through the *master take-off jet*, past the idle needle and so through the *cruise jet* into chamber C. The idle needle is of large diameter and is linked with the throttle spindle in such a manner that from the nearly closed or idling position it is withdrawn completely in the first ten degrees of throttle travel.

Mixture regulation on idle is effected by moving the idle needle in or out from its seat by an external adjustment. Since the needle is located directly in the main fuel circuit in the carburettor there can be no flat spot on opening the throttle. When the throttle is opened to enter the cruise range the needle is withdrawn, and the fuel flows past it and so to the cruise and economiser jets. On this model (known as the "Airflow Economiser") the manual control takes the form of a movable needle which can be pushed forward so as to restrict slightly the orifice of the cruise jet. This gives the auto-lean cruising mixture position. Withdrawing the needle completely gives the auto-rich mixture position, while moving the needle right forward so that the flange seats on the jet itself gives the idle cut-off position. The operation of the full rich position will be described in connection with the Altitude Control.

Enrichment for take-off and high power is effected by the economiser needle, which by its contour and movement permits the required amount of fuel to pass through into chamber C. In this model the economiser is governed by another and smaller diaphragm, one side of which is in communication with chamber A, the other side with chamber B. When the pressure differential reaches a certain predetermined figure the diaphragm will move suffi-

PRESSURE INJECTION

ciently to withdraw the needle and allow fuel to pass. The rate of the spring loading and the contour of the needle itself give the necessary graduation of mixture enrichment as power increases.

The practical form of this arrangement is shown in Fig. 2. On other models the enrichment diaphragm is controlled by the fuel differential instead of the air differential. This is known as the "Fuel Head Enrichment Valve," the details of which are clearly shown in Fig. 3. It will be observed that here the valve giving the manual mixture positions is of the rotary disc type, but the general scheme of operation remains the same.

The Altitude Control

The Altitude Control is a self-contained unit which screws into the air intake of the throttle body (Fig. 4). Within the outer casing is a sylphon filled to about 80 per cent. of its capacity with inert oil. The remaining space being filled at a given pressure with nitrogen. The oil is used to dampen out vibration and hysteresis, and is a special inert fluid having a low viscosity change with temperature. The needle is attached directly to the sylphon, so eliminating levers and other linkages, and callibration is arranged by the rate of spring loading and the shape of the needle.

Referring to Fig. 1, it will be observed that the impact pressure to chamber A passes the altitude needle valve, so that the position of the needle will govern the pressure in chamber A. Thus, as the aircraft climbs the sylphon will expand, pushing down the needle and restricting the pressure in chamber A. This will, of course, lower the pressure differential across the air diaphragm and restrict the fuel supply, so weakening the mixture. It will be noted that the reduction of fuel takes place at the source of fuel entry into the carburettor, so that the basic shape of the sea-level mixture ratio curve should be unaffected.

Located in the vertical channel below the altitude needle will be seen a disc valve, which opens or closes a passage by-passing the needle valve. The disc valve is linked with the manual mixture control, and when closed as shown in the diagram the altitude control functions in the normal manner. When the valve is rotated to the open position, the altitude control is by-passed and has no effect on the mixture strength. This is the full rich position of the mixture control.

A vacuum-operated accelerating pump is incorporated in the system, and is generally located in the flange adaptor between the throttle body and the blower casing. It is a simple single or double diaphragm pump with engine suction on one side and fuel on the other, and takes its feed from the C chamber fuel.

The Vapour Separator is an interesting device. It will be seen at the top of the strainer chamber in Fig. 1. It is, in effect, a small float assembly, the needle of which seals a vent which is piped back to the fuel tank. Any vapour either forming or being fed into the carburettor rises to the top when the float falls, so opening the vent orifice and permitting the vapour to escape.

A manifold injection system such as this is seen to possess most of the advantages of cylinder injection without the chief disadvantages of the latter, i.e., high cost of manufacture, high weight and complication. In addition to the characteristics of non-icing, etc., outlined at the beginning of this article, the Stromberg system possesses yet another most important advantage. This is the fact that the design of the carburettor permits it to be tested after manufacture or overhaul on a comparatively cheap and simple rig that will reproduce complete test results comparable with the full-scale airbox blower tests necessary in the case of the orthodox aeroplane carburettor. Space forbids the elaboration of this aspect of the system, but it is one that has far-reaching effects upon the service of aircraft carburettors. It should be added that the carburettor is handled in this country by the Zenith Carburettor Co., Stanmore, Middlesex, to whom service enquiries should be addressed.

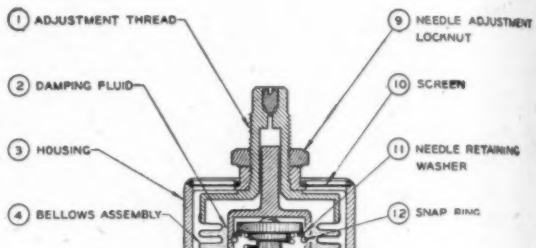


Fig. 4. The altitude control unit.

THE FORD AERO ENGINE

Further Details Show it to be in the 2,000 h.p. Class

THROUGH the courtesy of *Intava World*, it is possible to give further particulars about the Ford V-12 aero engine, the illustration of whose mock-up was published in *Flight* for August 21st. Its displacement is 1,650 cu. in., and the company aims to produce an engine developing between 1,800 and 2,000 h.p. at 3,600 r.p.m. at take-off. Layout was started in July, 1940, and three months later a two-cylinder experimental unit was running. This gave 250 h.p. at 3,000 r.p.m.

Air intake to the exhaust-driven turbo-supercharger and the exhaust from the turbine are both in the direction of flight, so reducing drag from the intake and getting some propulsive effect from the exhaust. Fuel is injected directly into each cylinder. By increasing the overlap of exhaust and inlet valves, a small quantity of compressed air enters the combustion space at the top of the stroke just before the injection of fuel and so ensures better scavenging and cooling of exhaust valve and piston head. The crankshaft is cast, and there is liberal overlap between crankpin and main bearing. Cylinders and upper half of the crankcase are an integral aluminium alloy casting with water jackets the full length of the cylinder barrels. The cylinder liners are of the "dry" type made of centrifugally cast oil-hardened steel.

The connecting rods are side-by-side, which makes them identical; bearings are floating. Length and diameter of piston are approximately equal. Cruising revs will be between 2,700 and 3,000, and it is expected that the engine will develop 1,500 h.p. at the latter speed. The supercharging is designed to maintain power up to 32,500ft. Supercharger, exhaust turbine, and intercooler are all integral with the engine, which weighs complete 1,600 lb. The supercharger and turbine are designed as a result of the company's own researches into the many problems involved in a new engine.

PILOT BUGGY

Ground Trainer for Learning Control Co-ordination

MUCH of the time spent in training student pilots is devoted to instilling into them the fundamental use of elevator, ailerons and rudder, and their proper co-ordination. Lack of this familiarity with the controls can be a source of danger to the pilot as well as the aeroplane, as quick, instinctive responses to certain situations are very necessary.

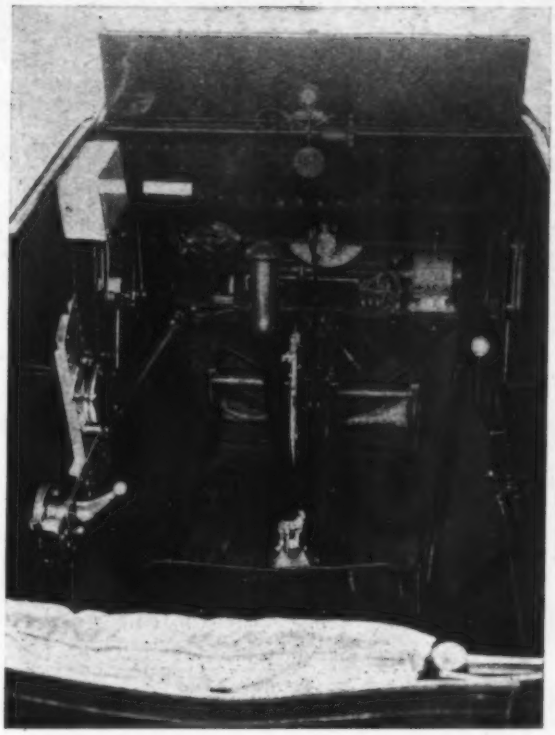
The U.S. Army Air Corps hopes to shorten the training time and substantially reduce the accident rate by use of the curious device here illustrated, dubbed the "pilot buggy," which is being studied to ascertain its effectiveness. It was conceived and designed jointly by Col. William C. Ocker and Maj. Carl J. Crane, of the Air Corps, as a reflex trainer for teaching control fundamentals on the ground prior to actual flight training, and the first model was built in the Air Corps engineering shops at Wright Field, Ohio.

Banking Cockpit Seat

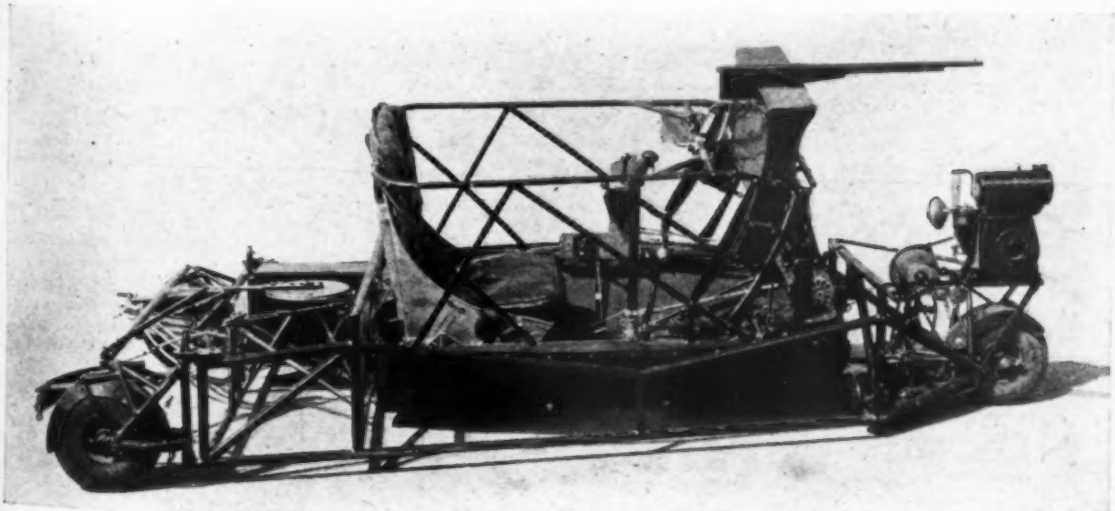
A cockpit equipped with a standard aeroplane seat and actual controls, including stick, rudder, brake, throttle and machine-gun trigger, is suspended in a built-up tubular frame mounted on three small wheels and driven by a small petrol engine. The machine is operated on any large, smooth-paved area, and the new student, with left hand on throttle, right hand on the stick and feet on the rudder controls, simulates flying without leaving the ground.

The cockpit is hung on bearings so that it banks in response to stick movement, just as an aeroplane does in flight. If the student makes a mistake in co-ordinating the controls and overbanks or underbanks, a warning horn sounds. The operation of a machine-gun can be practised also in conjunction with manipulation of the usual flight controls. The cockpit and front end of the "pilot buggy," shown fully exposed in one photograph to reveal the mechanism, are covered with detachable fabric coverings when in use.

A fair assumption is that the obvious safety of the machine will be an important factor in shortening the training period by relieving the novice of fear and giving him the confidence that is essential to concentration and full functioning of memory when learning co-ordinated operation of the controls. If this type of trainer proves as effective as expected, its extensive use should save some of the instructors' time and economise in the use of aircraft, besides enabling the student to learn piloting more quickly and with greater safety. It will be one more step in the graduation of flying training and, though it will never supplant the Link, it may save some time on that much more expensive piece of equipment.



The student has throttle, stick and rudder bar and the "buggy" responds to them. Should it be over-banked or under-banked an electric horn sounds.



This "pilot buggy" was designed by two U.S. Army Air Corps officers to save training time. It simulates, as far as is possible on the ground, the flight movements of an aeroplane and allows the student to practise co-ordination of controls.

Topics of the Day . . .

. . . OR TOPICS OF TO-MORROW?

"Indicator" Enlarges on His "Back to Front" Theme : The Possibilities of Jet-propulsion

THE trouble with a war is that nobody can possibly spare the time and energy to follow up really new lines of development—unless these show signs of immediate success. It is necessary, as I've said before, to concentrate mainly on obviously productive things; in other words, on improvements to present designs rather than on brand-new ideas.

A week or two ago I talked a lot of nonsense and a certain amount of sense about such things. I know in my bones that there will eventually be some quite staggering changes in our ideas about aircraft development. Whether this change will be in the airframe (to use the official word covering all the bits other than the motive power) or through a sudden leap forward in power unit design, nobody has any means of knowing. One will vitally affect the other.

Quite obviously, the change in the first named must come when aeroplane speeds approach the speed of sound. As I tried to explain in vaguely humorous terms, the present shapes of fuselages (dear me, *what* a dated word!) and wings must necessarily then be altered out of all recognition. The conventional streamline shape will no longer get along at all because it will be trying to push a great mass of air in front of it—and air can be immensely immovable and vicious at high speeds.

The Shape of Things

The wretched aeroplane will, as I said, need to change its shape altogether, in the air and at a critical moment, if an enormous amount of power is not to be wasted in pushing the "below-700-m.p.h." shape through the air until it is ready to fit into the "above-700-m.p.h." universe—a totally different and peculiar universe where fronts have to be sharply pointed in order to cleave the solid mass of air. The same will apply to wing sections, too, so the difficulties are nothing if not tremendous.

Maybe we shall have to give the whole thing up when such speeds are reached. In any case, there will be considerable loss of life and material during the initial experiments. A conventional aeroplane, for instance, might be expected to develop the most extensive structural faults as the critical speed is reached, and the devices developed for dealilng with the change-over will certainly not be reliable or perfect at the first attempts.

It has never seemed to me that the prime-mover to be used for such speeds presented any outstandingly great difficulties. Instead of a complicated mechanism driving a fan affair to push the air behind (and consequently the aircraft forward) you have our dear old friend rocket-propulsion—but rocket-propulsion on a new and most scientific scale. It is most wasteful to produce a tangled piece of machinery full of bangs and forces in order to do the very simple job of pushing air about. Why not use the bangs and forces a little more directly?

At "sound-speeds" an airscrew will be beyond consideration, and in any case the drag of the necessary fittings (even if the engine is buried in the aircraft) will be much too great and complicated.

Whenever one thinks of rocket-propulsion it is difficult not to visualise an erratic and highly dangerous departure in a mass of sparks and a great volume of noxious smoke. One moment R.1 is sitting on its rails (shades of Hiram Maxim), ready to go, and a split-second later everybody is coughing and spluttering, the aerodrome buildings are on fire, and the once beautiful R.1 is strangely missing.

Of course, it has crashed in the next field. The port rocket failed to ignite at the correct moment, so that the outfit has made a sharp dash to port, through some trees, and has now set a cornfield alight. The inventor and his crew didn't know much about it. They were all killed by the acceleration, anyway. Sparks, bangs, a big tubular affair with little wings, and a long-haired, wild-eyed inventor making a short statement to the Press (who will later print it all wrong) before climbing into his expensive and shiny coffin. . . That sort of thing.

Somebody ought to remove the word "rocket-propulsion" from our consciousness. "Jet-propulsion" is so much happier. There isn't really much difference between a jet-projected spate of air and an airscrew-pushed slipstream—except that the former stands a reasonable chance of being straightforward, while the latter twists all over the place and causes people to have headaches while designing tail surfaces. Jets are good things. They can be at the back of the machine, and there is no reason why they shouldn't be moved about through a few degrees in any direction. That might be an advantage in providing directional control.

Organised Explosions

Now, for pushing air (or whatever) down long, narrow passages there are more efficient things than fans—and why have a separate prime-mover anyway? Why not organise a series of explosions down the tube so that the velocity of the gas is gradually and remorselessly increased up to a maximum of a thousand miles an hour as it leaves the end of the tube? The initial push is given by some kind of motor-driven blower—if such an initial push is necessary. During the take-off, only a few "servo-bangs" are used, more coming in as the aeroplane gathers speed.

There will be nothing peculiar or cranky about my jet-propelled aircraft—nothing, that is, except the whole thing, which will have to be designed from zero. A thousand propulsive experts will first settle down to the production of an "explosion drive" in its lightest, most compact and simplest form; absolutely standardised and with no odd bits of tube or insulation tape about the thing. Then, when it is perfect, these experts will be taken smartly away and prevented from further meddling, while another thousand aircraft designers will be brought in to build an aeroplane round the completed jet motor. A special aeroplane for the purpose—none of this absurd business of saving money by fitting half-baked, semi-developed jet motors into a standard aircraft. The whole affair must be original from the word "Go," and all the experts must go first to psycho-analysts and mesmerists to have their pre-conceived notions forcibly removed—leaving only their experience in heat-motor and aerodynamic development.

The Wherewithal

Capital? It will cost about as much as three days of this war, and it will need to be a national concern, not a private affair with a couple of million shareholders squawking for results and dividends. Such squawking would panic the managers and designers into premature attempts to produce something out of their Number Nine hats. "Indicator," having started the work, would take part of the capital, buy a fair-sized cutter or sloop, and disappear towards the South Seas—returning every few years to see how the thing was progressing—and always supposing that the Japanese have left the South Seas in the same shape.

In all probability these S.S. would be a mass of loose mines and all the inhabitants of every island would be found to possess Mark IV respirators and tin hats. That being the case I should return forthwith by armed merchantman and take the greatest pleasure in making the first and fatal flight in the device. Or, alternatively, arrange secretly to have it redesigned to take me to some other planet where conditions are a little more humane and rational.

"INDICATOR."

JET PROPULSION of AIRCRAFT

PART II.—More Designs of Aircraft Units Employing Rotary and Reciprocating Compressors : The Work of British, Swedish and Swiss Engineers

By G. GEOFFREY SMITH

THE discussion in *Flight* of August 28th of the possibilities of jet propulsion for aircraft and the foreign examples illustrated have served to draw attention to progress in an entirely new field of research. New, that is, to the vast majority of aircraft technicians whose whole attention would appear to have been concentrated upon the improvement of accepted types of aircraft. It is, indeed, strange that so revolutionary a technique as the propulsion of aircraft by the reaction of a high-velocity jet of gas from a nozzle should have come into prominence at this particular juncture and be engaging the attention of the scientists and the Governments of many countries. The immense improvement in the efficiency of airscrews, which until comparatively recent times had tended to exercise a retarding influence upon engine development, the wonderful advancement in aero engines, with two-speed, two-stage or exhaust-turbo superchargers, would seem to have implied that the technical excellence of aircraft propulsive units would admit of no challenge from a fundamentally different angle of development. Yet it is a natural process, with a parallel in other spheres. Consider wheels, for instance. From the crude wooden disc to the spoked type, later the wheel shod with an iron rim, and, finally, the beautifully developed rubber-tyred carriage wheel. Then came the revolutionary pneumatic tyre, which allowed speeds to be raised enormously, and was developed, in its high-pressure form, to have reliability and long-wearing qualities until it secured universal adoption. A virtual perfection seemed to have been achieved when, like a bolt from the blue, the low-pressure balloon tyre appeared. This provided a degree of comfort that no previous form of spring suspension device had been able to attain. It literally marked a new motoring era, and rapidly superseded the high-pressure type.

The introduction of the Parsons steam turbine is an example of the sudden appearance of a new system of propulsion, which was destined to oust a form of power unit that had held unchallenged sway for a very long period.

Jet propulsion may or may not emulate the examples quoted in point of time, but what is clear is that the concentrated attention of the world's research scientists and engineers has brought various jet reaction systems to such an advanced state that successful flight is well within the bounds of possibility. This apart from the brief flight reported to have been made in Italy last year by the Campini machine illustrated in the first article of this series.

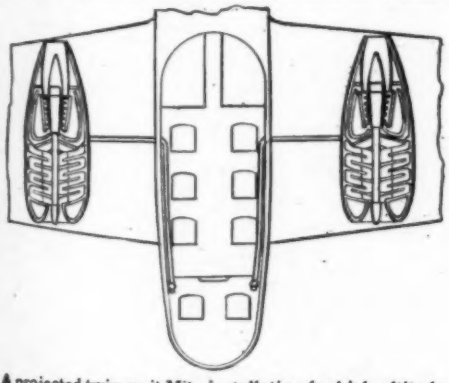
It should here be interpolated that the jet propulsion now under consideration has little relation to the application of the reaction principle as exemplified in rocket propulsion. Certain newspaper writers have confused the issue when taking up the discussion. The aims of both may, in general, be identical: high speed, high-altitude flight, rapid climb and elimination of many problems of stratosphere flying, by converting liabilities into assets. There is, however, a fundamental difference. In rocket propulsion the oxygen necessary for combustion is embodied in the explosive substance employed. For thermal-jet propulsion the oxygen required for the combustion of the fuel is taken in from the surrounding atmosphere.

IN a former article ("Flight," August 28th) the possibilities of jet propulsion for aircraft were discussed and progress in a new field of development revealed for the first time. Italian and German schemes were described and illustrated. In these notes the review is continued and examples shown of jet impulse reaction projects of British, Swedish and Swiss engineers. A further article on the subject will follow

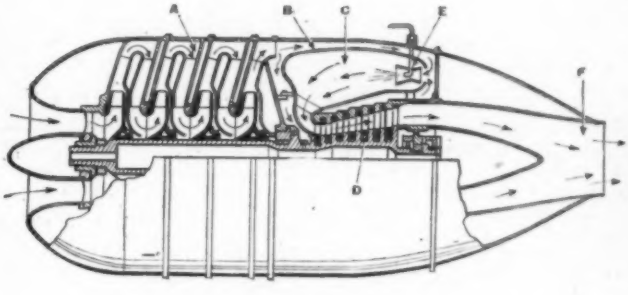
The Germans employ an omnibus title for the principle of jet propulsion: "Heissluftstrahltriebwerke." The French term for jet propulsion units is "Thermopropulseurs." At the Paris Salon in 1938 a French conception of the future aeroplane was exhibited in model form. It was a mid-wing monoplane with a highly streamlined fuselage inside which the propulsive organs were to be carried. Its ambitious specification included: Speed, 1,000 k.p.h.; h.p., 14,000; ceiling, 30 km.; wing area, 16 m²; weight, 2,000 kg.

As I intimated in former notes, British engineers have been in the forefront of progress with jet propulsion for aircraft, a number of patents having been granted during the last twenty years or so. The names most prominent in this field of development are H. S. Harris, as early as 1917, and F. Whittle.

In the following notes we continue a review of the main features of promising jet-propulsion layouts, this time of British, Swedish and Swiss origin. Attention is particularly drawn to the Schurter scheme, in which the distribu-

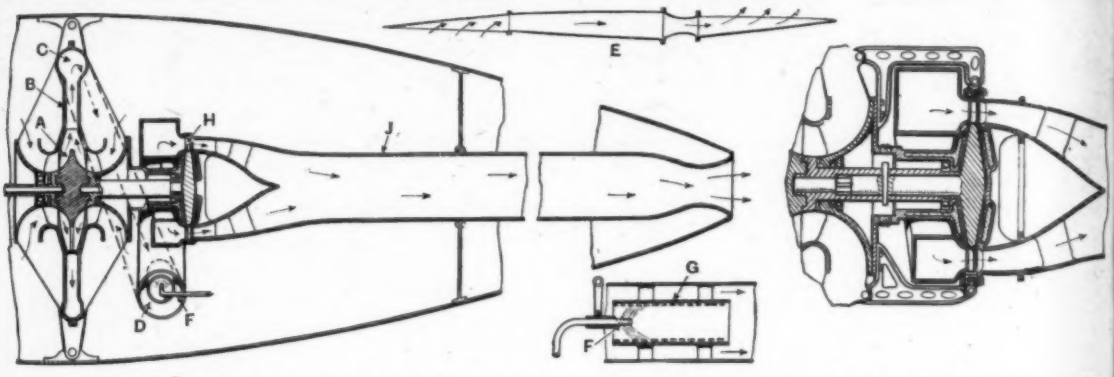


A projected twin-unit Milo installation for high-altitude aircraft. From each compressor aggregate air is tapped off to raise the pressure in the cabin and also to provide heat. This supply is, of course, controlled from the cabin.



The streamlined Milo unit is intended for wing installation. All the air compressed by the multi-stage blower is passed to the combustion chamber and, with added fuel, is expanded through the multi-stage gas turbine. The final conduit is a diminishing area to increase the velocity of the discharge.

JET PROPULSION OF AIRCRAFT



A Whittle propulsion plant mounted directly in the tail of an aircraft. Air is first admitted to the interior of the fuselage and then picked up by the high-speed rotary compressor. The turbine casing and rotor bearings are fluid-cooled.

tion conduits may serve as structural members of a fuselage or wing. Embodied as a leading-edge wing spar they would furthermore overcome the possibility of icing at high altitude.

Both the Milo and Ljungström designs from Sweden are for streamlined units, presumably intended for wing installation. A feature of the first-mentioned is a scheme for withdrawing compressed air from the propulsion units to charge and warm the pressure-type cabin of high-altitude craft. In the Ljungström's plant special arrangements are made for rapid acceleration and also emergency lifting or braking efforts.

Several British jet-propulsion schemes must be credited to F. Whittle. The compact, single-jet plant illustrated in this article utilises high-speed rotary components in order to minimise weight. Chief interest attaches to the blower-type compressor designed to secure the high mass-flow of air through the system which is the basic requirement for propulsive efficiency. All the air delivered by the compressor, together with the combustion gases of the fuel, are passed through a single rotor turbine which drives the compressor. The earlier scheme of H. S. Harris was an interesting single compressor aggregate with dual combustion chambers exhausting into long diffuser tubes into which air was admitted to increase the jet mass. Some notes on this design will be given in a succeeding article.

A British Plant

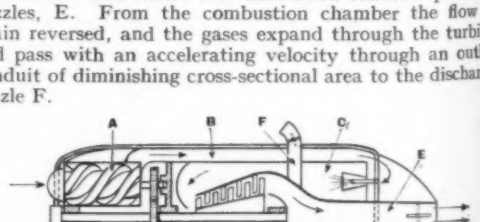
To revert in more detail to the Whittle plant, it will be seen from the drawing that this is enclosed within the fuselage. Initially the air can be admitted either by way of a suitable orifice facing forward or by a series of scoops suitably located to collect the boundary layer from the fuselage shell. The compressor has two air intakes, arranged one on each side of the plane of rotation of the impeller A. This component is rotated at such speed that the air leaves the tips of the blades at super-sonic velocity. For considerations of flow it is desirable that the air speed should be reduced to a sub-sonic velocity before reaching any stationary part of the blower. Accordingly, the air is delivered first into the radial primary diffuser chamber, B, which discharges into the delivery scroll, C, of increasing cross-sectional area. At its outlet the scroll is directly connected to a helical combustion chamber, D. At first the combustion chamber is of tapering form so as to constitute a secondary diffuser for the compressor, and the discharge end of the chamber is connected to the volute turbine nozzle. This extends around the periphery of the turbine, constituting a single annular orifice, so that the blade ring of the turbine rotor is at all times open to the gas blast. At E the various parts are shown in a plane development to illustrate the gas circuit from the compressor chamber to the turbine.

The air is heated by the addition of fuel introduced to the combustion chamber through injector, F, surrounded by a cowl, G. The inner wall of this cowl may be covered with a perforated metal or a wire mesh, as indicated in the small detail drawing, to produce a boundary layer of air at a reduced velocity. The air and combustion gases give up part of their energy to the turbine rotor, H, to drive the air compressor. After leaving the turbine, the air passes into an annular collecting chamber formed as a divergent channel between the discharge conduit, J, and a cone mounted on the turbine casing. The conduit is continued to the rear, and terminates in a convergent-divergent propulsion nozzle in the tail of the aircraft.

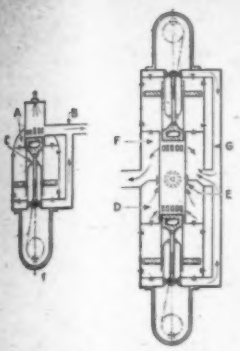
Where two propulsion plants of this type are installed on a single craft they may be arranged to rotate in opposite directions in order to reduce the gyrostatic couples to a minimum. Certain Whittle designs were reviewed in *Flugsport* in 1938.

Some Swedish Systems

Streamlined units for wing installation, to the design of A. Lysholm, are sponsored by Milo Aktiebolaget, of Stockholm. In one of these, shown in part-section, the air enters by an axial orifice, is compressed in a multi-stage blower, A, and delivered to chamber, B. This chamber houses an annular combustion chamber, C, and the gas turbine, D, which drives the blower. The air, preheated in its passage over the walls of the combustion chamber and the turbine stator casing, at the rear reverses the direction of flow and enters the combustion chamber past fuel nozzles, E. From the combustion chamber the flow is again reversed, and the gases expand through the turbine and pass with an accelerating velocity through an outlet conduit of diminishing cross-sectional area to the discharge nozzle F.



A Ljungströms Angturbin unit embodying dual, twin-rotor blowers for compressing the air. Special arrangements are made to permit rapid speeding-up of the compressor to provide sudden acceleration of the aircraft when taking-off or in case of emergency.



Schurter single-piston and opposed-piston compressor aggregates. A double-acting compressor piston is directly attached to each single-acting, two-stroke engine piston. An air-cushioning cylinder is provided below each piston. The work expended on the working stroke is returned in raising the piston on the compression stroke.

Another illustration shows two of these units installed in the wings of a high-altitude aircraft. From each of these a regulated supply of compressed air is tapped from chamber, B, to charge and warm the pressure cabin.

Plants of similar type are proposed by Aktiebolaget Ljungströms Ångturbin. In addition to a unit constructionally resembling the Milo design previously described, the one illustrated is of interest, as it employs a pair of twin-rotor, screw-type compressors, A, gear-driven from the turbine shaft. Air taken in at the forward end is delivered by the blowers through the receiving chamber, B, to combustion chamber, C, where the fuel is added, and thence to a turbine, D, with a double reversal of flow direction as before.

Special consideration, however, is given to means for increasing the propulsive effort with the utmost rapidity. This is of importance for the take-off of the craft and also when landing, should the pilot overshoot his point, or danger arise of collision with an obstacle. Under normal conditions control is effected by regulation of the supply of injected fuel. Should it be necessary rapidly to accelerate the speed of the craft, a substantial increase of the fuel supply would need to be suddenly applied. The initial temperature of the propulsive gases would then exceed safe values, since the compressor could not be speeded-up with sufficient rapidity to deliver a corresponding increase in the quantity of air.

Rapid Acceleration

Accordingly, to permit rapid acceleration without ill-effects, that part of the energy available for propulsion is temporarily reduced, and thus the power input to the compressor is increased simultaneously. The compressor speed is thus accelerated, the quantity of air delivered increases to an excess over that required for the fuel supplied, and the temperature of the propulsive gases is lowered. Thereafter it is permissible rapidly to increase the supply of fuel to correspond with the increased quantity of air, the normal fuel-air ratio is re-established, and the aircraft is accelerated. These operations can be completed in considerably less time than is necessary for the normal gradual increase of the supply of fuel.

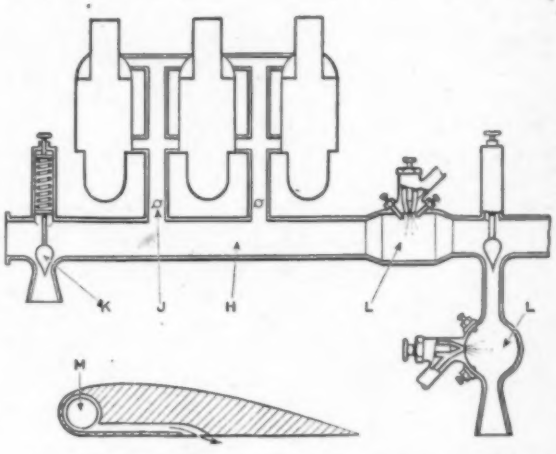
Control can be effected by either decreasing the back-pressure of the turbine exhaust gases or by decreasing the quantity of air admitted to the compressor. The former method is employed in the example illustrated. Normally the gases leaving the turbine are discharged through conduit, E, of diminishing cross-sectional area and furnished with a valve. From points adjacent to the turbine outlet, two auxiliary conduits, F and G, are fitted, each provided with a valve. Extending to the exterior of the casing, the outlets are directed forward and downward respectiveiy. For normal operation the three valves are positioned as shown in full line, but if the valve of either conduit, F, or G, is opened, the back pressure will be reduced. This results in an increased heat and pressure drop in the turbine, which is transformed into additional mechanical energy and applied to the compressor. Regulation of the conduit E valve and, selectively, either conduit F or conduit G valve, will produce respectively a braking or a lifting effect.

When starting up only a relatively small quantity of fuel is supplied, and the major portion of the energy is absorbed by the compressor whilst the propulsive means operates under no-load conditions. Consequently, an excess of air is provided in the combustion chamber, and the fuel supply may be suddenly increased to full-load quantity without ill-effect. With the plant running at approximately half-load when approaching a landing, a similar procedure will enable a sudden increase of fuel to be given to accelerate the craft in order to correct the direction of approach or to avoid an obstacle.

When regulation of the air admission to the compressor is employed for control, a throttle valve is provided in the air intake. With the valve partly closed, the quantity of air delivered is reduced, and the velocity of the discharged gases is lowered. If the fuel supply remains unaltered, the amount of energy by which the propulsive effort has been lowered will be imparted to the compressor. Obviously, both methods can be employed simultaneously on the same plant to produce the desired effect with more rapidity.

Swiss Reciprocating Units

Turning to Switzerland, we find the system proposed by W. Schurter, of Zürich, makes exclusive use of compressor aggregates of the reciprocating type. Single-piston or opposed-piston, high-compression, two-stroke engines are employed, and each piston is directly connected with a coaxial compressor piston. Both types are illustrated in schematic section.



Diagrammatic arrangement of a Schurter plant employing three single-piston compressor aggregates. The propulsive gases feed into a distributing conduit having controlled discharge nozzles and supplementary combustion chambers for boost. The detail sketch shows the distributing conduit arranged as a main spar for a wing and also serving to prevent ice formation on the leading edge.

Dealing first with the smaller unit, the single-acting engine piston is rigidly combined with a double-acting, annular compressor piston. Groups of admission and discharge valves are provided at each end of the compressor cylinder. One side of the compressor delivers scavenging and charging air, at approximately twice atmospheric pressure, to the engine cylinder by way of duct, A, and the scavenge ports. From the other side air is discharged into conduit, B, where it mixes with the combustion gases as they are leaving the engine cylinder by the exhaust ports. The engine piston is of the cross-head type and by means of a stationary abutment with a gland for the piston rod, a cushioning cylinder is arranged below the piston at C.

Of similar design the opposed-piston unit is virtually self-balanced, and the engine has the more satisfactory end-to-end scavenging action. The upper side of the lower compressor delivers air to chamber D, whence part is taken for scavenging and charging the engine, and the remainder is passed through the shallow annular passage, E, to the

JET PROPULSION OF AIRCRAFT

mixing chamber, F, thereby cooling, and absorbing heat from, the combustion zone of the cylinder. Air from the outer ends of both compressors passes through conduit, G, to the mixing chamber into which the lower side of the upper compressor discharges directly. The pressure drop, due to scavenging, is thus avoided in the major portion of the air compressed. It would, of course, be possible to construct a unit of this type as a free-piston engine-compressor. In any case the work of the engine, compressor and cushion cylinders can be so balanced that only relatively light mechanism is required to couple the crank drives.

Advantages of Combined Units

Combined units of this type would appear to offer advantages, since pre-compression of the air is effected at a favourably low pressure whilst high pressures are available for the efficient combustion of the fuel. At each working stroke the power developed is absorbed in compressing air in the corresponding compressor cylinder and the air cushion cylinder. Work expended in the cushion cylinder, and also on the residual air in the compressor, is usefully employed to return the engine piston on the compression stroke. Although the compressors work at only a relatively low pressure, the large number of automatically operated admission and discharge valves will scarcely be regarded with favour by aircraft engineers, particularly as a high engine speed is essential for the treatment of large volumes of air.

For a complete installation a plurality of compressor aggregates would be employed, as shown diagrammatically in the next illustration. Not all of these need to be continuously operative, and one or more could be cut off from the main distributing conduit, H, by the valves, J, to serve as reserve sources of power. Obviously, with such an arrangement it would be necessary to regulate the pressure and volume of the gases in conduit H, and valves, K, are provided for this purpose. These are spring-loaded and automatically vary the cross-sectional area of the discharge nozzles according to the pressure prevailing in the conduit. The tension of the springs can be adjusted during operation, and one or more nozzles can be completely closed or opened as required.

As the reaction gases in conduit H contain an adequate supply of oxygen and the temperature is relatively low (approximately 200 deg. C.) further fuel can be used to increase the power output. The efficiency of combustion at this stage is admittedly low, but the added propulsive effort could be usefully employed when taking off or climbing. Supplementary combustion chambers, L, may be provided in conduit H, and additionally, or alternatively, between the conduit and the discharge nozzles. The latter position would avoid the possible ill-effects of high temperature on the regulator valves, K. Each chamber is furnished with a fuel injection device and ignition equipment.

It is suggested that weight may be saved by forming conduit H as a leading-edge spar for a wing, or as a structural member of the fuselage. Embodied in the wing, as shown at M, it would serve to eliminate the danger of ice formation at high altitudes.

(To be continued.)

CANADIAN NEWS

Air Cadets and Canadian Waafs : Air Transport

A JUNIOR air force to give preliminary training for the Royal Canadian Air Force to teen-age boys has been started under the auspices of the Department of National Defence. Known as the Air Cadet League of Canada, the organisation follows closely the air force pattern of ranks, training and uniform, the boys appearing as junior replicas of their elder brothers in the Royal Canadian Air Force. Canadian reports say it is likely that 25,000 boys will have enrolled for the start of the new school year in September.

Boys between 12 and 18 years of age will have a training similar to the elementary training given in the air force. The basic course covers two years, a total of approximately 216 hours. Subjects covered include aircraft recognition, maps and map reading, a study of aero engines and aircraft construction, drill, armament, model building, theory of flight, signalling, first aid, knotting, mathematics and physical training. Advanced training, including aerial photography, aerial navigation, aircraft construction and radio, is planned for cadets who pass the elementary training.

The air cadets are on a voluntary basis, and parents must approve of their boys joining. Each boy must pass a medical examination. The headquarters are at Ottawa, but local organisations will be in charge of school boards, service clubs or other responsible bodies, who must provide adequate adult leadership and finance the unit. Cost of uniform is set at approximately £3 10s. per cadet. Minimum unit is a flight of 50 boys between 15 and 18 years of age, junior units being permitted for boys from 12 years up if a senior unit is in existence. The badge is an albatros with maple leaf above and "Air Cadets Canada" below. Squadron markings are worn on the shoulder, and rank badges are similar to those of the air force, cadets being eligible for promotion to non-commissioned officer ranks.

The Air Cadet League has come into existence as a result of requests for air training made by air-minded Canadian boys too young to join the Air Force. Private cadet corps had previously been started in several cities. The present organisation is closely tied in with the Air Force, with a number of officers acting as liaison, and inspections being made by Royal Canadian Air Force officers. Boys joining the air cadets do not automatically have to join the Air Force on attaining 18 years, but it is hoped that most will, and that the training they receive will save many months of Air Force training. The air cadets meet after school hours once or twice weekly, and in some schools have been formed as a part of the school cadet corps. Honorary president is Air Marshal Bishop, V.C.

Also being organised is the Canadian Women's Auxiliary Air Force. Members of the C.W.A.A.F. will not be called upon for any flying duties, but will release R.C.A.F. men for other duties by serving as cooks, mess waitresses, drivers of light motor vehicles, fabric workers, clerks, telephone operators, equipment assistants and general duties. A distinctive uniform has been designed. The R.C.A.F. has had the formation of the C.W.A.A.F. under consideration for more than a year in response to many offers from women's organisations to lend their assistance to the Air Force in order to free men for other duties.

Military Aircraft Production

Canada's production of aircraft in the second quarter of 1941 was 25 per cent. greater than during the first quarter, according to the Hon. C. D. Howe, Minister of Munitions and Supply. In terms of numbers, the monthly production will now be on the decline because Canadian plants are turning from the production of trainers to combat types, and also because plants already producing combat types are changing over to new designs. In addition, the

CANADIAN NEWS

Canadian industry is expanding to meet overhaul and repair needs, because of the tremendous increase in the number of aircraft in Canada. During the second quarter more than 200 aircraft were received from the United States and nearly 300 from the British Air Ministry.

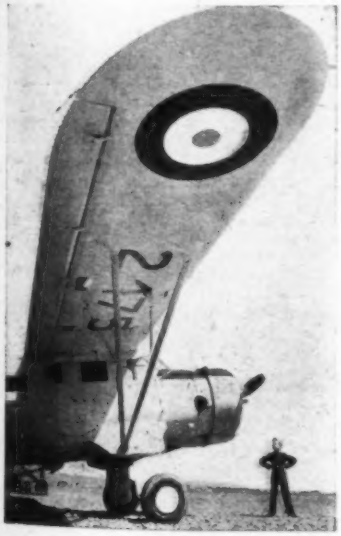
Reports indicate that orders for more than 1,000 aircraft have been awarded to Canadian aviation plants recently. Total cost is understood to run higher than $25,000,000. Canadian Car and Foundry Company will manufacture 400 Hurricanes at its Fort William plant, after which it will be engaged in turning out single-engine Harvard trainers at the rate of 80 a month for an indefinite period. An order for 500 Harvards is being given to Noorduyn Aviation, Limited, of Montreal. Destination of the planes was not officially disclosed, but there have been unconfirmed reports that the machines will be bought by the United States Government for distribution to China, the Netherlands Indies, and possibly Russia.

The new contracts will bring the total orders given for aircraft in recent months to about $60,000,000. National Steel Car Corporation, at Hamilton, Ontario, is working on 200 Martin B-26 bombers at a cost of $27,500,000, and Canadian Vickers, at Montreal, has an order totalling $7,400,000 for 39 Catalina airframes. These will also be built at the Vancouver plant of Boeing Aircraft.

Mr. Ralph Bell, Director of Aircraft Production, said he believed that no single aircraft in use to-day was of more importance to both Britain and Canada than the Catalina flying boat, because it is able to stay in the air for such a long time and is playing a vital part in the Atlantic patrols against submarines. Mr. Bell also announced that a repair and overhaul plant capable of maintaining all aero engines in use on the Pacific Coast will be operated at Vancouver Airport, Sea Island, by Canadian Wright, Limited, and British Aero Engines, Limited. The plant was built by the Dominion Government. The Canadian aircraft industry has expanded in a year and a half from 1,000 employees to the present total of 27,000, said Mr. Bell, and Canada's aircraft output now is close to 40 machines a week.

Civil Air Lines

The emphasis necessarily placed on military operations has not stopped, though it has no doubt curtailed air transport. The Dominion Bureau of Statistics reports in its monthly survey that passenger traffic of the Canadian air lines continues to follow an upward trend. The Bureau said 12,507 revenue passengers were carried in April, compared with 11,884 the previous month. Passenger-miles totalled 4,428,314, against 3,498,465. An increase of 15 per cent. was noted for passenger revenues, which totalled $275,461 in period under review, but air mail revenue declined to $260,355 from $332,678, a 22 per cent. decrease. Other transportation revenues fell 33 per cent. to $76,485, compared with $113,395.



One of the cadets, André Jobin, 14 years old, of No. 2 Jean de Brebeuf Squadron, Montreal, looks over—or should it be under?—a Noorduyn Norseman at St. Hubert Airport, Montreal.

Petrol used by all operators amounted to 363,853 gallons in April, and lubricating oil to 8,110 gallons, compared with 387,188 and 7,257 respectively. Number of employees was stationary at 1,600.

Use of air mail services of Trans-Canada Air Lines has increased so greatly that the gap between costs and revenue has become narrow, and the only cloud in a bright sky is the difficulty of obtaining additional flying equipment. In 1940, air mail carried by C.T.A. increased by an average of 4 per cent. per month, and in making their estimates for 1941 postal officials worked on the basis that there would be further increases. But each month their estimated figures were surpassed, with 91,423 lb. carried in March, 99,071 in April, 116,904 in May, and 118,942 in June. (In June, 1940, 68,270 lb. was carried.)

"This air mail service is a potential profit-maker," a postal officer said. "We are optimistic over the difference between cost of operation and revenue from the service being closed soon, with income meeting the outlay. We are definitely looking to the day when the air mail service will pay its own way and leave something of a profit."

Air bases being built from Edmonton to Whitehorse, Yukon, will be in use by autumn, according to J. A. Wilson, director of air services at the Department of Transport. This chain of bases is being carved out of virgin bush in the hinterland of British Columbia as part of the work of the United States-Canada Joint Defence Commission. All radio stations will be ready this autumn. Considerable difficulty is being encountered in getting supplies to the sites of these remote aerodromes.

The British need for airliners is affecting even the Canadian services, and Trans-Canada Air Lines and Yukon Southern Air Transport have both given up two Lockheeds. Those from Yukon Southern are Lodestars, and it is likely that the T.C.A. are of the same type. Cancellation of one of three daily return trips by T.C.A. between Toronto and Windsor follows this action, so that Canada is feeling the airline pinch (the word being used more metaphorically than literally) as well as the United States. It is not reported that Yukon Southern has had to restrict its services (which operate through Edmonton and Vancouver to northern British Columbia) but this may be because the aircraft were only recently received and probably had not gone into service.

Canada's new Air Cadets on a route march in uniform. But drill is only part of their training; they also learn about airframes, engines, maps, models, signals and theory of flight.

Atlantic Ferry Crash

THE third recent crash of transport aircraft flying over the Atlantic occurred on September 2nd when a transport flying from America crashed in an isolated and mountainous district on the west coast of Britain. The crew of four and the six passengers all lost their lives. The passengers were Professor Mowat, of the British Library of Information in New York and formerly of Bristol University; Count de Baillet-Latour, a Belgian diplomat; Capt. S. Picking, of the U.S. Navy; Mr. E. Y. Taylor, of the R.A.E., Farnborough; Lt. Col. Wrangham, of the Royal Marines, and Dr. Mark Benjamin, of the Central Scientific Office at Washington.

The delivery of aircraft across the Atlantic and the running of the transport service for high officials travelling between here and the United States has for some months past been under the charge of the Royal Air Force Ferry Command, having been taken over from Atfero, which worked under the Ministry of Aircraft Production.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters

STRATEGICAL BOMBING

The Long View Advocated

IN your recent issue you say all the evidence is against the theory of "strategic bombing." "The attacks on production must be maintained, of course, but so far in this war air power has proved itself chiefly potent when used to help land power or sea power." Now this is very shallow reasoning. Air power, *plus tanks*, did great execution in France, air power did great execution in Poland, but in both these cases the invaded countries had not sufficient fighters.

The General Officer Commanding in Greece stated that the effect of bombing was far more moral than physical, but I think you are again guilty of confused thinking. As I understand it, strategy is the planning of a war and the way it should be won. Tactics are the individual actions which carry out the strategy. In fact, therefore, every bomb which we drop is a tactical act. We have no German armies to bomb, as you suggest. Do you propose, therefore, that we should save up our bombers until there is an army to attack?

Furthermore, surely it is better to take the long view and shorten the war by destroying the enemy's means of production.

We are not able to bomb the German army, but we have bombed their shipping, we have bombed their harbours, we have bombed the possible invasion ports, we have bombed their aerodromes, we have destroyed their planes on the aerodromes, our fighters destroy their planes in the air. In Libya we have made use of tactical bombing ever since fighting started.

What in the name of goodness would you suggest that our people ought to have done? E. N. BRAY.

LANDING FLAPS

Some Notes on Their Design

ONE of the unpleasant effects of using landing flaps is the change of trim when they are lowered or raised.

This effect is more important than it appears at first sight, several flying accidents that have occurred in this country probably being partly attributable to it, and to help to overcome it the designer of one of our famous heavy bombers has found it desirable to incorporate a very complicated device connecting the flaps to the elevator trim. No doubt this was the only way he could do it once the machine was in production, but it could have been prevented by experiments and adjustments on the model.

As it concerns us, the effect on the slipstream around and behind the wing of lowering the flaps will be:—

(i) To increase the lift resultant and to move the centre of lift towards the trailing edge.

(ii) To increase the downward deflection of the slipstream.

The result of (i) is nose heaviness, while (ii) has the opposite effect, so it should be possible to make the two movements counteract each other given a constant C.G.

Having chosen a C.G. position, as seeming a typical landing load disposition, the aim is to achieve a balance so that with the trimming gear set to give "hands off" equilibrium at a certain speed (say, 120 m.p.h.) with the flaps up, the aircraft will be in equilibrium at the same or a slightly lower speed (90-100 m.p.h.) when the flaps are lowered.

The normal function of a flap is to increase both lift and drag. For a given chord, deflection of the flap to about 25 deg.-30 deg. is accompanied by a marked increase of lift, but beyond this point lift stays almost constant, the drag only continuing to increase. This is probably the reason why angles of 45 deg. to 60 deg. are the most common, and nose heaviness with flaps down the general rule. The opposite effect is met, however, sometimes to a positively dangerous degree, and is a condition which should not be permitted in any service aircraft.

Increasing the angle from 60 deg. to 90 deg. causes a notable increase of the deflection of the slipstream over the tail plane, nothing much being changed otherwise, and gives the required effect of counteracting the nose heaviness.

The increase of the chord of the flap to save 30 per cent. of the aerofoil chord gives an increase of lift for the same angle of deflection. This effect is more apparent for small angles of deflection than for larger ones, however, when the drag only is effected.

Thus it is obvious that the same lift and drag increments may be obtained for different deflections and chords. In our own case the compromise should tend towards a medium chord and a large angle of deflection, the exact figures being determined by wind tunnel experiments on the model.

The author had the opportunity of experimenting in this way, both in the wind tunnel stage and in actual flight, on at least three aeroplanes, with very successful results.

It must be emphasised, however, that ideal trimming can be obtained for one C.G. position only. If it is forward of this position, lowering the flaps will cause nose heaviness and vice versa.

Considering an aerofoil with a flap, stabilised by a tail plane—

"L" is the lift resultant applied at a distance "d" from the C.G., and "l" is the lift resultant of the tail plane acting at a distance "D" from the C.G.

For equilibrium, $Ld = lD$.

Were the C.G. to move forward through a distance Δ, the new moments would be:—

$L(d+\Delta)$ and $l(D+\Delta)$ as $L\Delta > l\Delta$, the result is nose heaviness.

The reverse effect will occur for a backward movement of the C.G.

Nevertheless, actual practice showed that it was quite easy to land the aeroplanes concerned without adjusting the trimming tabs with the C.G., both in the extreme forward and backward positions. S. R.

COUNTER-ROTATING AIRSCREWS

Torque Reaction Not Eliminated?

YOUR article on the counter-rotating Rotol airscrew in *Flight* for August 21st says: "Quite obviously, therefore, there is much to be said for an airscrew system which does away at one and the same time with the twisted slipstream and with torque reaction. . . ."

But *does* a counter-rotating airscrew eliminate torque reaction? (There is, of course, no argument about it straightening out the slipstream, or nearly so.) How does the engine know what happens to the torque after it has delivered it to the crankshaft? The engine is simply concerned with developing a certain torque and therefore tends to rotate in a certain direction (the opposite). This tendency to rotate is the torque reaction. If this were not so, the system of power measurement (by measuring torque and speed of rotation simultaneously) would become meaningless for an engine with a contra-prop—the engine would have no tendency to rotate, torque would be zero and therefore power would be zero! But nevertheless the engine would be eating up petrol and turning out exhaust gas and developing forward thrust, so how could its power be zero? It seems to me that the statement in your article is wrong; but your paper does not often make mistakes, and if I am wrong perhaps you or one of your readers will correct me. "MYSTIFIED."

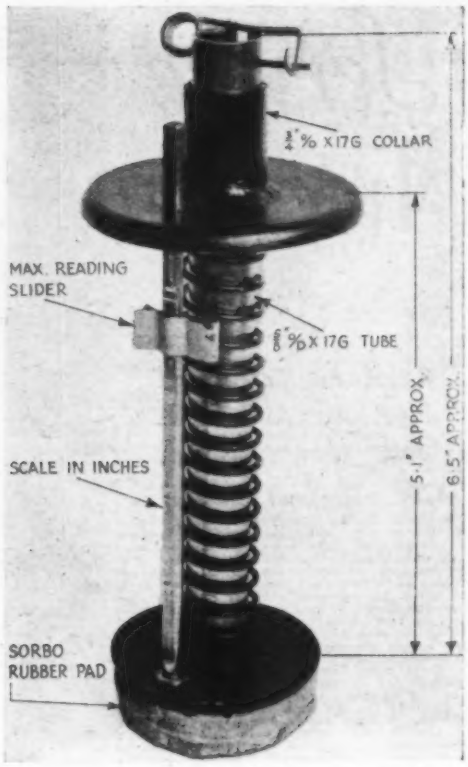
[Do any readers see whether or not fallacies are involved in this reasoning?—ED.]

Airscrew De-icing Shoes

THE maintenance department of Trans-Canada Air Lines has found that there is great difficulty in distributing de-icing fluid along the entire length of the leading edge of the airscrew, about 23in. from the hub being the maximum to which they found it flowed. Their observation of icing indicated that ice could form along the entire leading edge of the blade, over 30 per cent. of the chord on the cambered side and over the whole of the flat side. A rubber leading edge shoe with grooves for conducting the fluid has been developed and is being improved by the B. F. Goodrich Company. Fluid has already been distributed as far as 45in. out and the shoe is now being developed to extend to within 6in. of the airscrew tip.

STICK FORCES

A Neat Little "Gadget" for Determining the Force Required to Operate the Control Column



On the left the D.H. stick force recorder in use. On the right, the smallest model of the instrument, with most important sizes indicated.

"SHE is heavy on the controls." That, or the opposite, must have been said of hundreds of aeroplanes by thousands of pilots. Yet it is very difficult to get any quantitative measure of such qualitative statements. The De Havilland Aircraft Co., Ltd., have recently brought out a simple instrument designed to provide the answer. A household spring scale from Woolworth's would have done the same, except that the hook would not conveniently fit all types of plain stick top or handgrip, nor would it have the recording feature possessed by the D.H. "gadget."

The construction of the instrument is simplicity itself: a spring held between two collars, one of which is free to slide, and a slider on a fixed rod, moved along the rod by the pressure of the collar. When the load on the spring is released the slider remains at the maximum position, which can be read off afterwards. The rod, by the way, is graduated in inches. It could, of course, be graduated in pounds if that were considered desirable.

In use the instrument is placed with the Sorbo pad against the top of the stick, front or back, or on either side, according to whether the elevator forces or aileron forces are desired.

Advantages of the stick force recorder are that it is cheap, simple and does not lose its calibration. As it is not attached to the stick, it can be carried about from one aircraft to another. The limitations are fairly obvious: the pilot does not "feel" the handgrip while he is using the instrument, and the recorder cannot be used during complicated manœuvres in which ailerons and elevators are worked together.

Where the recorder should be particularly useful is in measuring forces on the stick under free static longitudinal stability investigations. With it, it is also possible to measure rapidly the stick forces described by pilots as heavy, normal or light.

Three spring sizes will give ranges of load from 0 to 60lb., so that the instrument should be suitable for any size of aircraft. The pitch diameter is ⅝in. in all three sizes, but the sizes vary with the loads and pressures in accordance with the following table:

Spring Size	Load lb.	Pressure lb./in.
15 G. × 17 coils × 5.2in. free length	0-18	5
13 G. × 24 coils × 6.7in. free length	14-37	8
12 G. × 28 coils × 6.75in. free length	28-60	15

Electric Arc Welding

VULTEE AIRCRAFT, Inc., is now using electric arc welding in place of welding by the oxy-acetylene gas torch for assembling tubular structures such as fuselages and engine mounts. Both methods produce welds of equal quality, their welding foreman claims in an article in *Aviation*, for July, but the electric arc has the advantage of superior speed. Machines of 200 amp. capacity are used and the tubing welded is nearly all of the SAE X-4130 (chrome-molybdenum) specification. Outside diameters range from ¼in. to 2½in. and wall thickness from 0.031 to 0.120in. The electrodes used are of the mild steel covered type of diameter ranging from $\frac{1}{16}$in. to ⅛in. Tubing must be cut more precisely for electric arc welding than for gas welding as the allowable gap with the electric process is smaller.

Factory to Battlefield

AFTER his historic conference with Mr. Churchill in the Atlantic, President Roosevelt announced that American combat aircraft for the British air forces in the Middle East would be delivered by means of a ferry service to be conducted by Pan American Airways. The President said that Pan American were setting up at once an airline from West Africa to the Middle East and plans were in hand for a transatlantic service to connect the United States with the new line. Its western terminus may be in Guiana or Trinidad.

The New York Herald-Tribune, however, announces that Pan American has been operating a service to Monrovia, Liberia, and Bathurst, Gambia, for the past three months and that its primary function has been the return of ferry pilots to U.S.A. from West African ports.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

A.T.C. Regional Commands

IN organising the Air Training Corps on a regional basis, with seven regions in England and Wales each under a Regional Commandant, it is emphasised by the Air Ministry that it is not intended to restrict the initiative and self reliance of A.T.C. committees and units. It is recognised that the success of the movement has been due largely to local enterprise and the same must be true of its future progress. The rapid growth of the A.T.C., however, has made necessary this further measure of decentralisation of command and administration, the seven Regional Commandants being directly responsible to the Commandant A.T.C. (Air Commodore Chamier).

In this regional organisation, official recognition is given to the formation of A.T.C. Wings and Districts. A Wing will be formed whenever there are two or more squadrons in the same town administered by the same committee and will be under the command of an officer responsible to the Regional Commandant. Units not forming part of a Wing will be supervised by a District Inspecting Officer. Areas covered by the London County Council will be administered as a District directly under A.T.C. Headquarters.

The seven new Regional Commandants appointed are:—Air Comdre. Sydney Smith (North-east), Grp. Capt. H. R. Busteed, A.F.C. (North-west), Wing Cdr. J. A. C. Wright, A.F.C. (Midland), Lt.-Col. T. W. C. Carthew, D.S.O. (Eastern), Sqn. Ldr. C. F. Gordon, M.C., D.F.C. (South-east), Air Comdre. H. P. Smyth-Osbourne, C.M.G. (South-west), and Wing Cdr. G. B. Bailey, D.F.C. (Wales and Monmouthshire).

HIS MAJESTY has granted unrestricted permission for the wearing of the undermentioned decoration conferred on the officer indicated in recognition of valuable services rendered in connection with the war:—

CONFERRED BY THE BELGIAN GOVERNMENT.
CROIX DE GUERRE BELGE.

Act. Sqn. Ldr. Michael Lister ROBINSON, D.F.C.

DIVE-BOMBER: A Vought-Sikorsky Chesapeake two-seater dive-bomber with British markings.

THE KING has been graciously pleased to approve the undermentioned awards, in recognition of gallantry displayed in flying operations against the enemy:—

In July, 1941, large scale attacks were made on German warships at Brest and La Pallice, including the *Gneisenau*, *Scharnhorst* and *Prinz Eugen*. A smaller attack was made on Cherbourg. The operations were carried out in daylight and extremely heavy and accurate anti-aircraft fire and fighter opposition were encountered by all aircraft when approaching the target, which at Brest was protected by a balloon barrage.

The air crews engaged succeeded, nevertheless, in securing direct hits on their objectives and in inflicting very severe damage in the target area. During the combats with enemy fighters twenty-one hostile aircraft were destroyed and others were severely damaged. The precise timing of attack by the various formations of aircraft and their correct approach to and accurate bombing of the objectives, in the face of such powerful opposition, demanded great skill and high courage. The great success of these operations was largely due to the bravery, determination and resource displayed by the following officers and airmen, who participated in various capacities as leaders and members of the aircraft crews:—

The number after each name represents the squadron with which the recipient is serving.

DISTINGUISHED SERVICE ORDER.

Wing Commander R. A. C. CARTER, No. 150.
Wing Commander G. T. JARMAN, D.F.C., No. 76.
Acting Wing Commander R. S. ALLEN, D.F.C., R.A.F.O., No. 106.
Act. Squadron Leader T. P. A. BRADLEY, D.F.C., No. 35.
Act. Squadron Leader H. BUDDEN, D.F.C., No. 104 (missing).

DISTINGUISHED FLYING CROSS.

Wing Commander F. W. DIXON-WRIGHT, No. 99.
Wing Commander Roger H. MAW, No. 12.
Wing Commander W. S. P. SIMONDS, No. 104.
Act. Wing Commander V. S. BUTLER, No. 226.
Squadron Leader Charles N. FLEMING, No. 142.
Squadron Leader Laurence J. STICKLEY, No. 40.
Act. Squadron Leader W. B. KEDDY, No. 405 (R.C.A.F.).
Act. Squadron Leader Gordon V. LANE, No. 103.
Flight Lieutenant Peter E. DODSON, No. 142.
Flight Lieutenant Roy Douglas MAX, No. 103.
Act. Flight Lieutenant K. M. BASTIN, R.A.F.V.R., No. 76.
Act. Flight Lieutenant R. I. POOLEY, R.A.F.V.R., No. 115.
Flying Officer Norman BUTLER, No. 99.
Flying Officer G. A. ISBELL, R.A.F.V.R., No. 218.
Flying Officer W. St. Clair MCNEILLY, No. 142.
Flying Officer E. A. MORRISON, R.A.F.V.R., No. 99.
Flying Officer Arthur James H. ROBERTS, No. 103.
Flying Officer A. J. SMITZ, R.A.F.V.R., No. 57.
Flying Officer Charles STOKES, No. 75 (N.Z.).
Act. Flying Officer G. M. BRISBANE, D.F.M., No. 76.
Pilot Officer J. A. DUNCAN, R.C.A.F., No. 40.
Pilot Officer James Paul ERLY, R.C.A.F., No. 106.
Pilot Officer J. HENDERSON, R.A.F.V.R., No. 106.
Pilot Officer A. B. PAYNE, R.A.F.V.R., No. 12.
Pilot Officer R. H. SUTTON, R.C.A.F., No. 104.
Warrant Officer G. W. HOLDEN, R.A.F.V.R., No. 25.

DISTINGUISHED FLYING MEDAL.

Flight Sergeant Albert ADDERLEY, No. 115.
Flight Sergeant Frederick F. BARKER, No. 103.
Flight Sergeant Henry JOHNSTON, No. 115.
Flight Sergeant Ronald V. C. OLIVER, No. 44.
Flight Sergeant R. E. PARSONS, R.C.A.F., No. 408.
Flight Sergeant Tegwyn WILLIAMS, No. 44.
Sergeant John Dudley ARMSTRONG, No. 104.
Sergeant Harold BROADBENT, No. 99.
Sergeant Edward CALLANDER, No. 75 (N.Z.).
Sergeant John Frederick Keith CORK, No. 115.
Sergeant H. R. CORRIN, R.N.Z.A.F., No. 75 (N.Z.).
Sergeant George Alexander FRASER, No. 76.
Sergeant Patrick Clement GEARY, No. 150.
Sergeant Thomas GOULD, R.A.F.V.R., No. 40.
Sergeant Herbert Reginald HIGGINS, No. 35.
Sergeant Gwyn MARTIN, No. 75 (N.Z.).
Sergeant Alexander Douglas MORRIS, No. 40.
Sergeant Arthur Percy OVERALL, No. 106.
Sergeant Mark Antony SACHS, No. 35.
Sergeant Arnold WELDON, No. 150.

CRUDE BUT USEFUL: Biplane ambulances are used by the Russians to get urgent cases to hospital. The camouflage paint is interesting and there is no sign of the international Red Cross marking.

PRESSING THEIR SUIT : One of the many trades for which an aircraftwoman of the W.A.A.F. can muster is that of "batwoman."

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy :—

BAR TO THE DISTINGUISHED SERVICE ORDER.

Act. Grp. Capt. F. V. BEAMISH, D.S.O., D.F.C., A.F.C.—Grp. Capt. Beamish commanded an R.A.F. Station from October, 1940, to March, 1941, and during that period carried out 71 operational sorties in which he destroyed an enemy fighter, probably destroyed three other hostile aircraft and damaged others. Since his appointment to Group headquarters he has taken part in further sorties and has probably destroyed two more enemy aircraft. The courage and devotion to duty displayed by Grp. Capt. Beamish are of the highest order, and he has set a magnificent example.

BAR TO THE DISTINGUISHED FLYING CROSS.

Sqn. Ldr. J. RANKIN, D.F.C., R.A.F.O., No. 92 Squadron.—This officer was appointed to command the squadron in February, 1941, and, under his leadership, it has destroyed fifty-three enemy aircraft. Of this number Sqn. Ldr. Rankin has himself destroyed at least thirteen; in addition he has damaged three enemy aircraft. He has on several recent occasions led the wing with great success, and has at all times displayed the greatest keenness to engage and destroy the enemy.

DISTINGUISHED FLYING CROSS.

Sqn. Ldr. A. H. DONALDSON, A.F.C., No. 263 Squadron.—This officer has shown himself to be an excellent leader, and has carried out seven offensive operations against the enemy over Northern France and Belgium. During these operations he has destroyed and damaged a number of aircraft on the ground and inflicted considerable damage to buildings and dispersal pens. Once while returning to base with his squadron he attacked six anti-aircraft barges, one of which was sunk and three damaged. Sqn. Ldr. Donaldson has by his leadership, gallantry and initiative in action set an excellent example, and is largely responsible for the successful operations carried out by his squadron.

P/O. D. C. DOUGALL, R.C.A.F., No. 92 Squadron (missing).—This officer has performed consistently good work since joining this squadron, and has shown great keenness to engage and destroy the enemy. He was shot down recently when warning his leader, whose radio apparatus had failed, that enemy aircraft were about to attack. The warning was given by visual signals, and necessarily took some time after he had sighted the enemy. He showed the greatest devotion to duty and disregard of personal safety. P/O. Dougall has destroyed one enemy aircraft.

Act. Sqn. Ldr. J. HARRISON-BROADLEY, No. 82 Squadron (missing).—In June, 1941, this officer participated in a successful formation attack on an enemy convoy, strongly protected by destroyers, south of Pantelleria. Despite heavy opposition from the destroyers, which opened fire when the formation was four or five miles from the convoy, Sqn. Ldr. Harrison-Broadley persisted in his mission. When two or three miles from the convoy the port engine of his aircraft was hit and caught fire. In spite of this Sqn. Ldr. Harrison-Broadley flew on, but when closing in to the attack his starboard engine also caught fire. His flying speed, however, carried him the short distance necessary to enable him to drop his bombs, one of which struck a ship. With both engines on fire, Sqn. Ldr. Harrison-Broadley was compelled to descend on the sea after passing over the ship. By his splendid leadership and courage this officer contributed largely to the success of the operation.

Act. Flt. Lt. E. P. WELLS, R.N.Z.A.F., No. 485 Squadron.—This officer has served with fighter squadrons since May, 1940, and has taken part in many engagements against the enemy. He has destroyed at least five of their aircraft and has damaged others. He has at all times shown the greatest courage and determination.

F/O. H. S. WOODWARD, R.A.F.V.R., No. 600 Squadron.—This officer has shown great perseverance and keenness during night-flying operations and has destroyed three enemy aircraft. One night in May, 1941, his aircraft was set on fire when a considerable distance out to sea. Nevertheless, F/O. Woodward succeeded in flying the burning aircraft back over this country and did not abandon it until he had first ensured that his observer had left the aircraft safely. In pressing home his attacks against the enemy F/O. Woodward has displayed great skill and determination.

F/O. E. W. WOOTTEN, No. 234 Squadron.—This officer has displayed great dash, enthusiasm and flying ability throughout all the operations in which he has participated. He has destroyed at least five enemy aircraft, of which two were shot down in one engagement.

P/O. W. T. de R. WATERS, R.A.F.V.R., No. 53 Squadron.—In August, 1941, this officer was pilot of one of two aircraft detailed to search for enemy shipping in the Borkum area. A convoy of one large merchantman escorted by five destroyers was observed, and both aircraft flew low over the water to attack. They were met by very heavy fire, and, whilst taking avoiding action, a wing of P/O. Waters' aircraft struck the water and the tip of the wing was torn off. He then flew into cloud without attacking, but, finding that his aircraft was flying correctly, he again searched for the convoy, and, on finding it, attacked in a position which necessitated flying down the line of the enemy fire. P/O. Waters displayed gallantry and determination in the face of strong opposition.

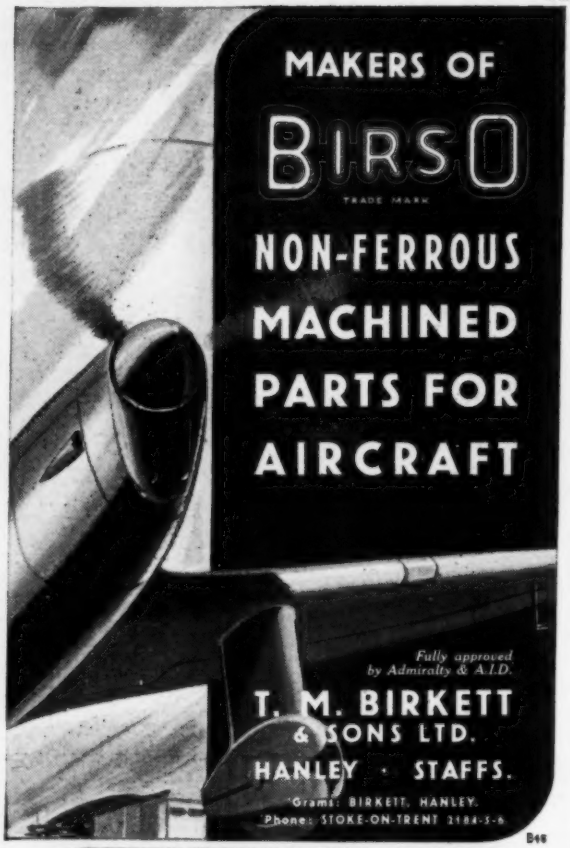
DISTINGUISHED FLYING MEDAL.

Sgt. J. FLINT, R.A.F.V.R., No. 49 Squadron.—One night in July, 1941, Sgt. Flint was captain of an aircraft detailed to attack a target in North-west Germany. Shortly after crossing the Dutch coast the aircraft was held in a large concentration of searchlights and was hit several times by the fire from an enemy fighter. Sgt. Flint succeeded eventually in escaping from the enemy fighter and, unperturbed, resumed his course to the target. Later his aircraft was again held by searchlights, whereupon he took evasive action and had to descend 1,000 feet before getting clear. Sgt. Flint then set course for base, but when approximately 50 miles from the English coast the aircraft was attacked by two Messerschmitt 110s. Bursts from the enemy ignited Verey light cartridges, which exploded in the pilot's cockpit, and inter-communication was rendered impossible between the members of the crew. The port engine was also hit and put out of action, but Sgt. Flint continued to fly on the remaining engine, keeping only a few feet above the surface of the water, with the enemy still attacking from the rear. When about four or five miles from the coast the enemy aircraft withdrew, and shortly afterwards Sgt. Flint was compelled to descend on the water about 800 yards from the shore. His cool courage and determination, together with his calmness and skill, have set a splendid example to the members of his squadron.

Sgt. R. H. JAMES, No. 29 Squadron.—On the night of March 14, 1941, Sgt. James was observer air gunner of an aircraft which attacked a Heinkel 111 flying in the direction of the Humber. The cannons jammed after the first burst of fire and the Heinkel climbed to 15,000 feet. Although without oxygen Sgt. James, for a period of at least 40 minutes, struggled with his guns, changing the ammunition pans. When he had finished he fell to the floor of the aircraft completely exhausted, but his great determination and stamina enabled the Heinkel to be destroyed with the one gun which had been cleared. Sgt. James has shown keenness and extreme devotion to duty and has set an exceptionally high standard. He has taken part in the destruction of three enemy aircraft and in the damaging of another.

Sgt. D. B. WARK, R.A.F.V.R., No. 144 Squadron.—One night in August, 1941, this airman was wireless operator air gunner of an aircraft which, while returning from its target, was attacked by two Junkers 88's; the navigator, rear gunner and Sgt. Wark were all wounded. When the enemy aircraft approached again Sgt. Wark, although in great pain, fired a burst at 100 yards range and the enemy aircraft disintegrated. Sgt. Wark then proceeded to repair his damaged wireless set and gave his pilot bearings which enabled him to bring the aircraft safely back to this country. Sgt. Wark displayed coolness and outstanding courage, and, but for his efforts, the aircraft and crew would doubtless have been lost.

NOT A MUZZLE LOADER : An armourer cleaning the barrel of a shell-gun on a Spitfire V. Despite these projections from the leading edges, the Spitfire V has a speed of over 400 m.p.h.



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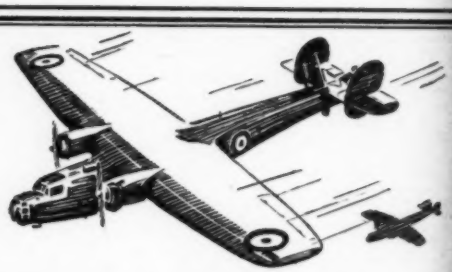

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